ANALYSIS OF RESULTS AND OUTCOME OF ARTHROSCOPY ASSISTED MANAGEMENT OF TIBIAL PLATEAU FRACTURES

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INSTITUTE OF ORTHOPAEDICS AND TRAUMATOLOGY
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CERTIFICATE

This is to certify that this dissertation titled **"ANALYSIS OF RESULTS AND OUTCOME OF ARTHROSCOPY ASSISTED MANAGEMENT OF TIBIAL PLATEAU FRACTURES"** is a bonafide record of work done by **Dr.Rajarajan E** during the period of his Post graduate study from May 2015 to May 2018 under guidance and supervision of **Prof.V.Singaravadivelu** M.S Ortho, D. Ortho,PhD. in the INSTITUTE OF ORTHOPAEDICS AND TRAUMATOLOGY, Madras Medical College and Rajiv Gandhi Government General Hospital, Chennai-600003, in partial fulfillment of the requirement for M.S.ORTHOPAEDIC SURGERY degree Examination of The Tamilnadu Dr. M.G.R. Medical University to be held in April 2018.

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DECLARATION

I declare that the dissertation entitled **"ANALYSIS OF RESULTS AND OUTCOME OF ARTHROSCOPY ASSISTED MANAGEMENT OF TIBIAL PLATEAU FRACTURES"** submitted by me for the degree of M.S. Orthopaedics,is the record work carried out by me during the period of May 2015 to May 2017 under the guidance of Prof.V.Singaravadivelu M.S.Ortho, D. Ortho, PhD. Professor of Orthopaedics, Institute of Orthopaedics and traumatology, Madras Medical College, Chennai. This dissertation is submitted to the Tamilnadu Dr.M.G.R. Medical University, Chennai, in partial fulfilment of the University regulations for the award of degree of M.S. ORTHOPAEDIC SURGERY (BRANCH-II) examination to be held in April 2018.

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INDEX

INTRODUCTION

Tibial plateau fractures are one of the commonest periarticular fractures in the knee joint. These fractures include 1% of all fractures [(1)]. Motor vehicle accidents account for majority of these fractures in young people, but in elderly people due to osteopenic bone these fractures may result from trivial fall.

These fractures which occur due to high energy violence have extensive soft tissue injury. Each fracture type has its own morphology, treatment considerations and prognosis. Apart from bony injury, meniscal tear and ligament injuries are associated with this type of fractures.

The treatment of tibial plateau fractures has completely changed from conservative treatment with casting to anatomical reduction and surgical fixation due to better understanding of the biomechanics of the injury, improvement in imaging modalities like fluoroscopy and anatomically contoured plates, need for soft tissue care and early postoperative rehabilitation.

Management of tibial plateau fractures remain challenging because of their various pattern of fractures, associated soft tissue and ligament injury, varying opinions regarding surgical management including traditional open reduction and internal fixation (ORIF) which

requires extensive soft tissue dissection, which may lead to numerous complications and risks such as wound necrosis, wound infection and arthritis.

Successful results depend on anatomical reduction, restoration of ligamentous stability, treatment of concomitant injuries and preservation of soft tissue envelope. Additionally, good visualization of the articular joint surface with minimal dissection of soft tissue can help in achieving this goal [2-5].

Tibial plateau fractures are difficult to treat. Surgical management of these fracturs are challenging. Tibial plateau fractures require extensive exposure for reduction of the fractures bone which leads to risk of infection and soft tissue complications. The surgical treatment for tibial plateau fractures should inflict minimal surgical trauma, to achieve desired satisfactory outcomes. Therefore, the indirect reduction has now become the standard option in the management of these fractures. Although indirect reduction has the advantage of avoiding extensive exposures, adequacy of joint articular surface reduction can be difficult to evaluate under routine intra -operative fluoroscopy. [6]

The potential benefits of arthroscopic assisted reduction of tibial plateau fractures and internal fixation are well documented[6]. Arthroscopy-assisted percutaneous tibial plateau fracture fixation is the option of treatment in Schatzker classification types I, II, III, and IV

fractures, as it ensures optimal reduction and stable fixation consistent with early mobilization. The option of percutaneous cannulated screw fixation is less invasive than open plate fixation. In all this tibial plateau fractures, arthroscopy may allow an evaluation of articular fracture reduction, thereby obviating the need for extensive arthrotomy. The use of arthroscopy for Schatzker Classification types V and VI has been suggested, to improve the quality of the reduction of the articular surface and must be combined with rigid fixation with a plate or external device. [7].

Arthroscopy assisted fixation assesses direct fracture reduction and have been utilized by some surgeons for a wide range of fracture patterns for over two decades. With arthroscopic techniques, the fractured articular surface is visualized less invasively than with wide arthrotomies and detaching or elevating the meniscus. In addition to assisting with fracture reduction, arthroscopy has further advantage of allowing associated intraarticular soft tissue to be directly assessed and treated [8]. Faster rehabilitation and more accurate reductions when compared to open techniques with arthrotomy have been reported. Good results have been reported for arthroscopic treatment for elderly patients, mostly for lower energy fractures. [8].

AIM

To Study the functional and radiological outcome of arthroscopic assisted fixation of tibial plateau fractures.

REVIEW OF LITERATURE

The management of tibial plateau fractures has been changed from conservative cast bracing to surgical management which includes external fixators, percutaneous fixation and traditional open reduction internal fixation with plates. Initially various types of external fixators were applied for soft tissue healing after high energy trauma. Due to inadequacy in reduction of articular surface with external fixators, open reduction and Internal fixation of Tibial plateau fractures were introduced. Non-operative methods were indicated for fractures that will heal without significant deformity in elderly patients and patients with high risk medical co-morbidities and also for deformities which are acceptable.

DeCoster et. al[9]., Delamarter and Hohl[10] used cast bracing for tibial plateau fractures for minimally displaced and undisplaced fractures.

DeCoster et. al[9] treated 30 patients with cast brace and found less favorable outcome for knee for complex bicondylar fractures

Apley[11] and Moore et. al[12]. used both initial traction and early joint mobilization, exercises which contributed for favorable outcome.

Duparc and Ficat et. al.[13] in their study of 159 cases of tibial plateau fractures treated conservatively and with surgery, showed better results for surgical management (54%) than conservative treatment(46%).

In early 20th century Palmer et. al[14,15]. reported two studies with surgical treatment of tibial plateau fractures which showed satisfactory results in short and long term outcome with surgical management.

Robert JM[16] in 1968 showed good results with 72% conservative, 80% traction mobilization, 81% surgical management among 100 cases of tibial condyle fractures. He also advocated early mobilization, preservation of meniscus and repair of torn ligament for best results.

Porter BB[17] in 1970 reported that the most important factor influencing the prognosis in tibial plateau fractures is the anatomical reduction of joint surface. In his study of 68 patients who were treated both surgically and non-surgically showed good excellent results in 96% of patients treated by conservative methods in patients with articular depression of less than 10 mm and 47% in patients with articular depression of more than 10 mm and 80% with surgical methods.

Schatzker et. al.[18] in 1979 achieved 88% acceptable results in 70 cases treated with Open reduction and Internal fixation with bone grafting.

Lachiewicz et. al.[19] in 1990 obtained excellent to good results in 93% among 43 cases treated by open reduction and Internal fixation with mean follow-up of 2.7 years. They found that poor results were due to faulty techniques or absence of bone grafts.

Delamarter et. al[20] studied that the soft tissue injuries associated with tibial plateau fractures are in 10 to 30 % of cases which need to be addressed preoperatively as well as after fixation. These injuries should be adequately treated to prevent instability of knee joint[14].

Tscherne et. al.[21] proposed a classification system for open and soft tissue injuries. Primary treatment for tibial plateau fractures includes closed reduction. If necessary open reduction internal fixation, bone and Soft tissue reconstruction were performed based on assessment of soft tissue condition.

Sushil H Mankar et. al [22] studied the outcome of complex tibial plateau fracture treated with external fixator which will help in reducing soft tissue complications if near anatomical reduction is achieved.

Thomas et. al[23] evaluated 18 cases in which they used meniscal detachment method for excellent exposure and accurate reduction of the joint. They showed 72% excellent and 38% good results.

Ballmer et. al [24] used small fragment implants for proximal tibia fractures in 17 patients which showed 86.7% anatomical or near

anatomical reduction in post-operative radiograph. During follow-up there were 53.3% excellent and 33.3% fair results following which they concluded that 3.5mm small fragment implants can be used with atraumatic soft tissue dissection for good results in management of proximal tibia fractures.

Mills WJ [25] studied high energy tibial plateau fractures and showed that open reduction and internal fixation, even though difficult with associated soft tissue injuries is advantageous over External fixation due to the ability to recognize and repair associated soft tissue injuries, greater Visualization of articular surface and avoidance of prolonged immobilization.

Jong-keun O [26] showed excellent results with Minimally invasive methods like MIPPO with lesser incidence of infections, soft tissue damage with high rates of early fracture union using smaller incision and Locking Compression Plate.

Sirkin et. al.[27]described various methods of percutaneous fixations available which offers best results in undisplaced fractures, Split Condylar fractures, Osteoporotic fractures and in comminuted fractures, which includes advantages of shorter surgery time and hospital stay, reduced blood loss due to minimal incision and early rehabilitation.

Proximal Tibia receives its blood supply from both periosteal and intramedullary network. During injury to the Tibial plateau the intramedullary network is disturbed but leave the periosteal supply intact. Percutaneous fixation of tibial plateau fractures preserves this supply intact which helps in preventing complications such as infection, necrosis and non-union [28].

Koval et. al. [29] used fluoroscopy for indirect reduction of tibial plateau fractures in 18 cases which showed excellent reduction in 13 cases.

Duwelius et. al [30], Harper et. al[31], Keogh et. al[32] reported excellent results with simple cases amenable to fluoroscopy and other complex cases required arthroscopy/ Arthrotomies.

Lobenhoffer et. al.[33]conducted a comparative study between fluoroscopy and arthroscopy and found that fluoroscopic assessment of tibial plateau with image intensifier was equivalent to and technically easier than assessing with arthroscope. Patients assessed with fluoroscopy did not have any clinical problems due to unrecognized soft tissue problems.

Arthroscopy Assisted Reduction and internal fixation (ARIF)in the tibial plateau fractures was first introduced by Caspri et al[34] and Jennings[35] in the 1980s.Currently Arthroscopic assisted reduction and

internal fixation is being widely used in the treatment of tibial plateau fractures.

Richard B.Caspari et al's [34]Arthroscopy is of value in the management of tibial plateau fractures. Acute fractures and associated soft tissue injuries can be precisely defined, allowing for timely management decisions. Based on direct arthroscopic observation, selected fractures can be reduced and stabilized with appropriate postoperative management.

TarekA.Aziz Mahmoud et al"s[36] prospective study of 20 patients with closed type fracture I-IV according to the Schatzker classification with step off of the articular surface more than 3mm and condylar widening more than 5 mm, They concluded that percutaneous fixation of displaced tibial plateau fracture with assisted arthroscopy is safe and effective procedure with excellent results and early mobilization.

G.Burdin CHU de Caenet al's[37] view in complex proximal tibial fractures is that arthroscopy may allow an evaluation of articular fracture reduction, thereby obviating the need for extensive arthrotomy. Complementary stable fixation is crucial and should allow early mobilization to reap the benefits of the arthroscopic assistance.

Jerome E Jennings Suite et al[38] states that Arthroscopy bridges that controversy, allowing the advantages of accurate reduction and

rigid fixation without extensive operative exposure. In addition, Arthroscopy allows thorough lavage, removal of loose fragments and accurate diagnosis of associated intraarticular pathology. Biomechanics of rigid percutaneous internal and external fixation are presented to demonstrate that no principles are compromised in arthroscopic management.

Xing-Zuo Chen et al[39] ,Arthroscopic Assisted Internal Fixation (ARIF) is a reliable, effective and safe method for the treatment of tibial plateau fractures, especially when they present with concomitant injuries. ARIF has also been suggested as a potential risk factor for compartment syndrome during arthroscopic examination or treatment.

Lemon and Bartlett [40] were the first to report an arthroscopic technique for reduction of displaced intraarticular fracture of tibial plateau.

Hung et. al.[41-42] recommended the use of arthroscopy for tibial plateau fixation as the articular surface can be easily observed and intraarticular structures can be examined and the fracture fragments can be fixed with minimal soft tissue damage.

Suganuma and Akutsa et. al[43] reported that arthroscopy assisted tibial plateau fixation is less invasive than open techniques and reduces the period of rehabilitation. They also advised these techniques can be

used when the displacement of fracture site is at least 5 mm or 3mm articular depression.

Yi sheng Chan et al[44] described Arthroscopy is straightforward in the diagnosis and treatment of meniscal and ligamentous injuries and removal of loose fragments with good early to medium-term results for arthroscopically assisted osteosynthesis of tibial plateau fractures. Arthroscopy is recommended for all tibial plateau fractures the best results can be achieved using arthroscopically assisted osteosynthesis of the fracture combined with arthroscopic management of the associated soft tissue injuries. It's a safe, reproducible and effective procedure.

Arthroscopically assisted reduction and fixation techniques are being used with increased frequency for the treatment of Schatzker type I, type II and Type III tibial plateau fractures. Arthroscopic techniques require minimal soft tissue dissection, afford excellent exposure of the articular surface, and can be used to diagnose and treat concomitant meniscal injury.

Buchko and Johnson [(45)]described an arthroscopic technique in which the affected extremity is placed in a thigh holder, a tourniquet is inflated and an anterolateral arthroscopic portal is placed approximately 2cm above the joint line to enable the surgeon to look downward on the tibial plateau. A complete diagnostic assessment is performed. A low pressure arthroscopic pump can be used but is not mandatory, although

it improves exposure and facilitates joint lavage. If the pump is used for extracapsular fractures (Schatzker type I, II and type IV), the metaphyseal portion of the fracture site should be covered to prevent extravasation of irrigation fluid into soft tissues. The incision can be used later to create a bony window for reduction and bone grafting. Schatzker type III fractures usually are intraarticular, and extravasation is less of a concern. The joint should be thorough lavage was given to evacuate the hemarthrosis and remove loose bony and chondral fragments. When the diagnostic evaluation has been completed, the reduction can be performed with the pump off or a dry arthroscopic technique. If the lateral meniscus is entrapped in the fracture site, it can be lifted out with a hook. Meniscal tears usually can be repaired and should be treated accordingly.

Depressed fragments can be elevated through a small cortical window. The depressed fragment can be localized by using an anterior cruciate ligament tibial guide to place a Kirschner wire into the displaced fragment. The fragment can be elevated using a cannulated impactor. The reduction can be evaluated accurately through the arthroscope and the appropriate bone graft substitute is used. Fixation is achieved with percutaneously placed 3.5 mm cortical screws. Because buttress plating may be necessary in patients with osteoporotic bone, arthroscopically assisted reduction is less suitable for this patient population. Small clinical series using arthroscopically assisted

reduction and fixation techniques in predominantly Schatzker type I, type II, and type III tibial plateau fractures have shown good and excellent results in 80% to 100% patients.

ANATOMY[46]

Anatomy knee joint which includes tibial plateau is necessary to plan the management and postoperative care to determine the possible complications after injury to the proximal tibial region. Tibial plateau includes area of the proximal tibia extending from articular surface up to the length corresponding to the maximum trans epiphyseal width.[46]

KNEE JOINT[46]

It is a large complex joint which consists of 3 joints

1) Patellofemoral (saddle joint)

2) Tibiofemoral (condylar joint)

3) Tibiofibular (condylar joint)

Knee joint transmits forces in excess of five times the body weight. Range of motion of knee joint is from 10º hyperextension to 140° flexion. The femoral condyles articulates with the proximal tibia throughout the range of motion.

Proximal tibia flares out from the shaft to form medial and lateral condyles of tibia. Tibial plateau is the articular surface of the tibial condyles which articulate with the femoral condyles to form knee joint.

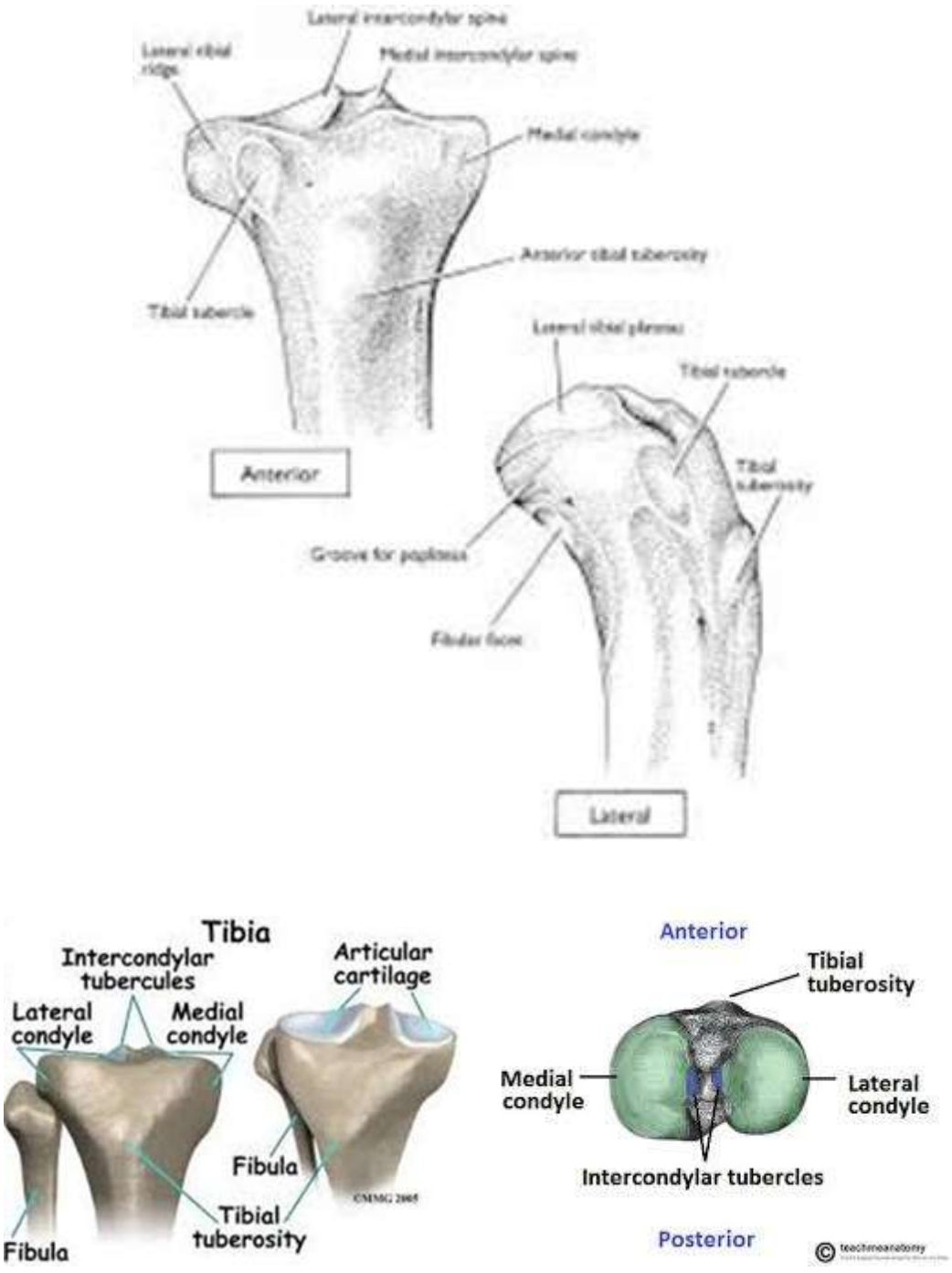


Figure :1,2&3

The tibial is sloped anteroposteriorly from 7º-1Oº in the knee joint. The spinous processes prevent translation of tibia from femur and protect the insertion of anterior cruciate ligament. Articular cartilage is absent in the most posterior portion of the interspinous region [46].

MEDIAL TIBIAL CONDYLE[46]

The medial condyle of tibia is larger than the lateral condyle of tibia. Medial tibial condyle articulates with the medial femoral condyle. Its articular sur face is oval and long axis is anteroposterior. It is concave centrally and flat peripherally. Peripheral part of medial tibial condyle is separated from the femoral condyle by the medial meniscus. Medial articular surface and the medial sub condylar region is much stronger than the lateral condyle of tibia, hence lateral condylar fractures of tibial plateau are more common than medial condyle fractures[46].

LATERAL TIBIAL CONDYLE[46]

The lateral plateau is higher than the medial plateau of tibia and is concave from front to back and from side to side. The tibial plateau are covered by hyaline cartilage approximately 3mm thick on the medial tibial plateau and 4mm thick on the lateral tibial plateau. The lateral meniscus covers the outer portion of the lateral tibial plateau. The posteroinferior aspect of the lateral condyle of tibia articulates with the fibula.

INTERCONDYLAR AREA[46]

It is the roughened area between the superior articular surfaces of the medial and lateral condyles of femur. Following structures are attached in this area from front to back.(Figure 5)

- ❖ Anterior horn of the medial meniscus
- ❖ Anterior cruciate ligament
- ❖ Anterior horn of the lateral meniscus
- ❖ Posterior horn of the lateral meniscus
- ❖ Posterior horn of the medial meniscus
- ❖ Posterior cruciate ligament

TIBIAL TUBEROSITY[46]

It lies at the upper end of the tibial shaft on its anterior border. A crest divides the tuberosity into a smooth upper and a rough lower portion which marks the epiphyseal line. Ligamentum patellae is attached to the smooth upper portion of the tibial tuberosity.

Knee joint is stabilised by the following structures

Figure 4

FIBROUS CAPSULE[46]

The capsule is attached 1cm above the articular margins of the femur and tibia. Its femoral attachment is deficient above the level of the patella. The capsule has weak attachment to the rims of the both menisci which are known as coronary ligaments.

MEDIAL COLLATERAL LIGAMENT(MCL)[46]

MCL is a flat band attached to the medial epicondyle of femur just distal to the adductor tubercle above and to the upper part of the medial surface of the tibia below. It represents the degenerated tendon of the ischial head of the adductor magnus.

LATERAL COLLATERAL LIGAMENT(LCL)[46]

LCL is attached proximally to the lateral epicondyle of femur, below the attachment of lateral head of gastrocnemius and above the tendon of the popliteus. Distally, it is attached to the head of the fibula and overlapped by the tendon of biceps femoris, a bursa intervening between them. The infero-lateral genicular vessels and nerves separate it from the capsule of knee joint.

OBLIQUE POPLITEAL LIGAMENT[46]

An ex pansion from the tendon of semimembranosus that blends with the capsule at the back of the joint and ascends laterally to the intercondylar fossa and lateral femoral condyle. The popliteal artery lies

on oblique popliteal ligament and the genicular vessels and nerve penetrate it.

CRUCIATE LIGAMENTS OF KNEE JOINT[46]

These are a pair of very strong ligaments connecting the tibia to the femur in the knee joint. They lie within the capsule of the knee joint, but it is extra synovial. It is covered by synovial membrane on their front and sides but not posteriorly.

The anterior cruciate ligament (ACL) is attached to the anterior part of the intercondylar area between the attachments of anterior horns of medial and lateral menisci. It has two bundles which ascends posterolaterally and attached to the posteromedial aspect of the lateral femoral condyle.

The posterior cruciate ligament (PCL)is stronger, shorter and less oblique. It is attached on the posterior part of the intercondylar area of tibia and its two bundles ascends anteromedially and is attached to the anterolateral aspect of the medial femoral condyle. The cruciate ligaments cross each other like the limbs of the letter “X”, the anterior ligament lying anterolateral to the posterior ligament.

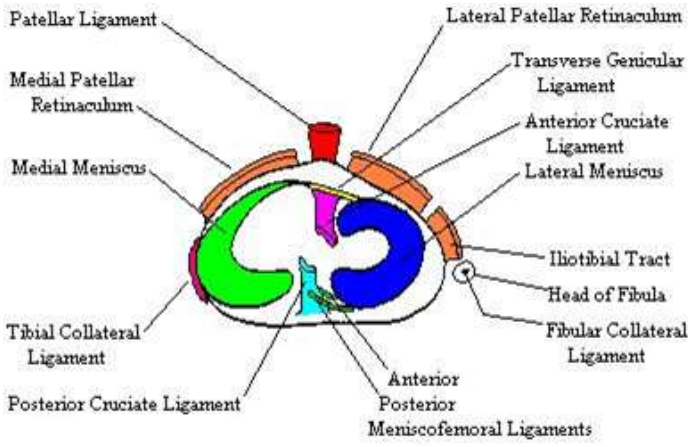
MENISCI (SEMILUNAR CARTILAGE)[46]

These are crescentic laminae of collagenous fibrous tissue that lie on and are attached to the tibial plateau.

The medial meniscus is almost a semicircle. It is broad posteriorly. Its anterior horn is attached to the intercondylar area in front of the ACL, while the posterior horn is attached in front of the PCL.

The lateral meniscus is about four-fifth of a circle and is of uniform width. Its anterior horn is attached in the intercondylar eminence of tibia behind the anterior cruciate ligament. The posterior horn is attached behind the intercondylar eminence in front of the posterior horn of the medial meniscus. The lateral meniscus covers larger surface of the articular surface than the medial meniscus. Meniscotibial ligaments are the structures which attach the menisci to the periphery of the tibial plateau. These structures are crucial to identify when performing a sub meniscal exposure to visualize the articular surface of the tibia. They can be carefully incised horizontally and must be repaired to avoid producing an iatrogenic peripheral meniscal detachment.

Figure :5



Knee Joint: Tibia - Superior View

SYNOVIAL MEMBRANE[46]

It is attached to the articular margins of the femur, tibia, patella and lines the deep aspect of the capsule, but it is separated from the capsule by popliteus muscle posteriorly and the cruciate ligaments inside the knee joint. Infrapatellar fat pad separates synovial membrane from the patellar ligament anteriorly.

LIGAMENTUM PATELLAE[46]

This is the central portion of the common tendon of insertion of quadriceps femoris, peripheral portions of the tendon form medial and lateral patellar retinacula of knee. It is about 3 inches long and 1 inch broad. It is attached above to the margin and rough posterior surface of the apex of patella and below to the tibial tuberosity. The superficial fibers pass in front of the patella. It is related to the infrapatellar bursa and to the infrapatellar pad of fat which separates from synovial membrane.

BLOOD SUPPLY OF THE KNEE JOINT[46]

Knee joint is supplied by anastomosis formed by genicular vessels from popliteal artery. Arteries forming this genicular anastomosis around the knee joint.

1) Superior genicular artery

2) Medial genicular artery

3) Lateral inferior genicular artery

4) Middle genicular artery

5) Anterior and posterior tibial recurrent arteries

NERVE SUPPLY[46]

All three nerves supply the knee joint

- ❖ Femoral nerve through its branches to vastii especially vastus medialis.
- ❖ Sciatic nerve through genicular branches of common peroneal nerve
- ❖ Obturator nerve through its posterior division.

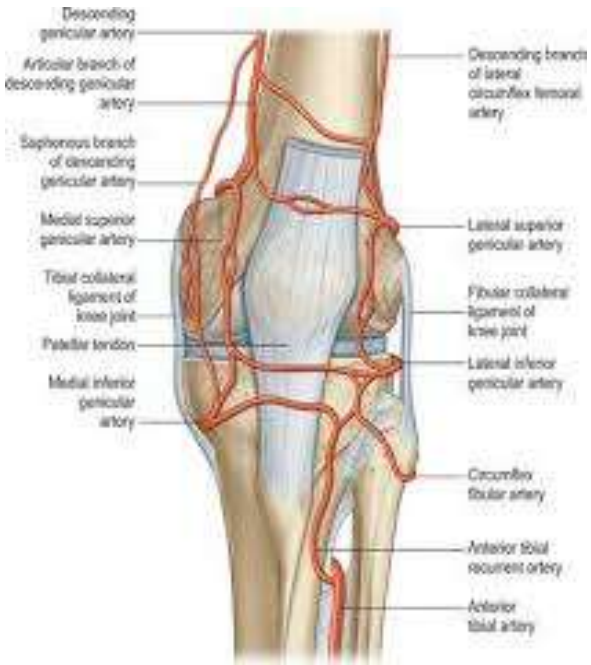


Figure:6

MECHANICS OF KNEE JOINT[46]

Because of the disparity between the lengths of the articular surfaces of the femoral condyles and the tibial condyles, two types of motion during flexion and extension of knee are produced.

1) Ginglymus (hinge).

2) Trochoid (pivot joint) articulation.

Knee joint permits flexion and extension in the sagittal plane and also some degrees of internal and external rotation when the knee joint is flexed.

The complex flexion and extension motion of knee is a combination of rocking and gliding. The rocking motion occurs in the first 20° degrees of flexion, after which the motion becomes predominantly of gliding type.

The natural outward deflection of the tibia on the femur at the knee joint produces greater weight bearing stresses on the lateral condyle of femur than the medial femoral condyle. But because the medial femoral condyle is prolonged forwards than the lateral femoral condyle, the vertical axis of rotation falls in a plane near the medial condyle.

Flexion and extension ranges from 0^0-140^0.

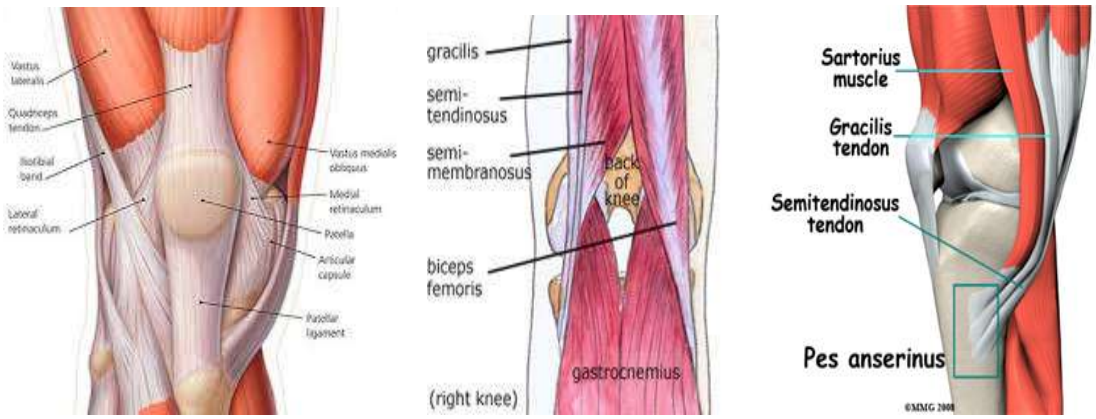
SCREW-HOME MOVEMENT[46]

The articular surface of the medial femoral condyle is prolonged anteriorly than the lateral femoral condyle. When the knee comes into full extension, the femur rotates internally until the remaining articular surface on the medial condyle comes in contact with the articular surface of the tibia. The posterior portion of the lateral condyle rotates forward, thus providing a screwing home movement, and locks the knee in fully extended position.

On initiation of flexion of knee, unscrewing of the joint occurs by external rotation of the femur on the tibia.

Normal varus and valgus movement at the knee, when extended is 6^0-8^0.

Muscles acting Around Knee Joint [46]



Figures :7,8 & 9

TIBIAL PLATEAU FRACTURES[47]

INCIDENCE

Fractures of tibial plateau constitute 1% of all fractures and 8% fractures in the elderly population. These fractures include many and varying fracture configurations that involve the medial condyle (10-23%), lateral condyle (55-70%) or both condyles (11-30%) with varying degrees of articular depression and displacement [47].

NATURE OF VIOLENCE

DIRECT

Automobile accident, which is one of the most frequently encountered mechanism of injury

1) Road traffic accidents/ automobile accidents.
2) Fall from height
3) Industrial accidents
4) Valgus stress/varus stress
5) Athletic injury
6) Assault

INDIRECT

Trivial injures like

1) Stumbling
2) Twisting
3) Missing steps, etc.,

MECHANISM

Fractures of the upper tibia occur due to strong valgus or varus forces along with an axial loading of knee.

When a patient sustains varus or valgus force with an axial load, the respective femoral condyle exerts shearing and compressive forces on the articular surface of the tibia. This frequently results in a split fracture, a depressed fracture or split depression fracture. Isolated split fractures are virtually confined to adults with dense cancellous bone that is capable of withstanding the compressive forces on the knee joint surface. With advancing age, strong cancellous bone of the proximal tibia gradually becomes more sparse and is no longer able to withstand the compressive forces. With impact loading, a depressed or split depressed fracture results.

The medial collateral ligament acts like a hinge when valgus forces drive the lateral femoral condyle into the tibial plateau. The lateral collateral ligament acts in the similar way with varus forces and causing medial tibial plateau fractures.

With the Magnetic Resonance Imaging (MRI) in patients with upper tibial fractures, ligament injuries have been observed in a higher percentage of patients with tibial plateau fractures. Thus, in addition to the fracture, there may be an associated medial collateral ligament or anterior cruciate ligament injury in lateral plateau fracture, conversely,

the tears of the lateral collateral ligament or cruciate ligaments may be associated with fractures of the medial tibial plateau.

The location of the fracture depends on the degree of flexion/extension of the knee. However, when axial loads exceeds 8000 pounds, explosive severely comminuted fractures are produced. This mechanism is thought to occur clinically in a fall from height on the extended knee.

Also, direct injury to the upper part of the tibia, i.e., in the sub condylar (or) subchondral or metaphyseal region may lead to a fracture without involving the articular surface.

- Depressed and split depressed fractures are common in older patients.
- Isolated split fractures are common in younger patients.
- Fracture line and degree of flexion of knee combined with valgus/varus strain and axial loading contribute to determine the fracture line and the site of depression whether it is anterior, middle or posterior.
- Collateral ligament integrity and forces determine the type of fracture.

- ❖ Pure axial loading or axial loading combined with valgus/varus stress determines the type of bicondylar fractures.
- ❖ Very High velocity injuries are associated with ligament and neurovascular injuries.
- ❖ Direct injuries to the upper tibia can also lead to sub condylar fractures without involving the plateau.

Many factors can contribute to produce different type of fractures, their combinations and complications.

CLASSIFICATION

Schatzker Classification[48]

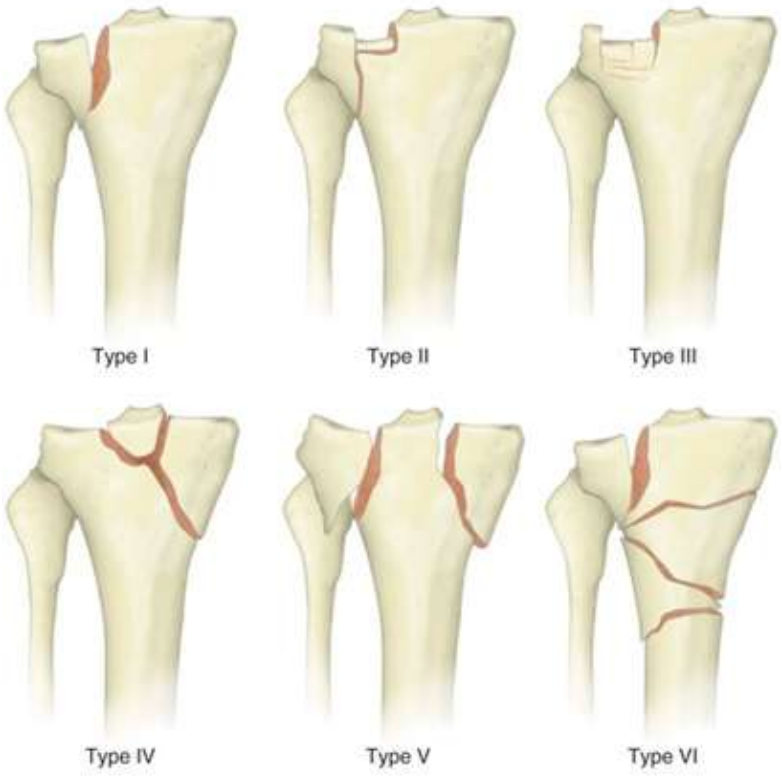


Figure:10

TYPE I-PURE CLEAVAGE

A wedge shaped uncomminuted fragment is split off and displaced laterally and downwards. This type is common in younger patients without osteoporotic bone.

TYPE II- CLEAVAGE COMBINED WITH DEPRESSION

A lateral wedge of fragment is split off and the articular surface is depressed down into the metaphysis. This type is common in older people with osteoporotic bone.

TYPE-III - PURE CENTRAL DEPRESSION

The articular surface is driven into the metaphysis. The lateral cortex is intact. These tend to occur in older patients with osteoporotic bone.

TYPE IV - FRACTURES OF MEDIAL CONDYLE

Medial condyle of the tibia may be split off as a wedge or may be comminuted. The tibial spines are often involved. These fragments tend to angulate into varus.

TYPE V - BICONDYLAR FRACTURES

Fracture of both medial and lateral tibial plateaus. The distinguishing feature from type VI is that the metaphysis and diaphysis retain the continuity. Intercondylar eminence may or may not be fractured. Sometimes only the anterior or posterior portions of both the condyles will be fractured and remaining portion will be intact. One

third of the bicondylar fractures will have a posteromedial fracture. These patterns are important in planning the treatment of these type of fractures.

TYPE VI - PLATEAU FRACTURE WITH DISSOCIATION OF METAPHYSIS AND DIAPHYSIS

A transverse or oblique fracture of the proximal tibia is present in addition to fracture of one or both tibial condyles and articular surfaces. The defining characteristic of type VI is metaphyseal diaphyseal dissociation with varying comminution of the articular surface. The fracture extends more distally in type VI than in type V. The amount of displacement and comminution of the articular surfaces vary and there is no sub classification of this pattern. It may also appear as proximal tibial fracture with an intraarticular extension. This type includes wide range of fracture patterns requiring different treatment strategies.

HOHL AND MOORES CLASSIFICATION[49]

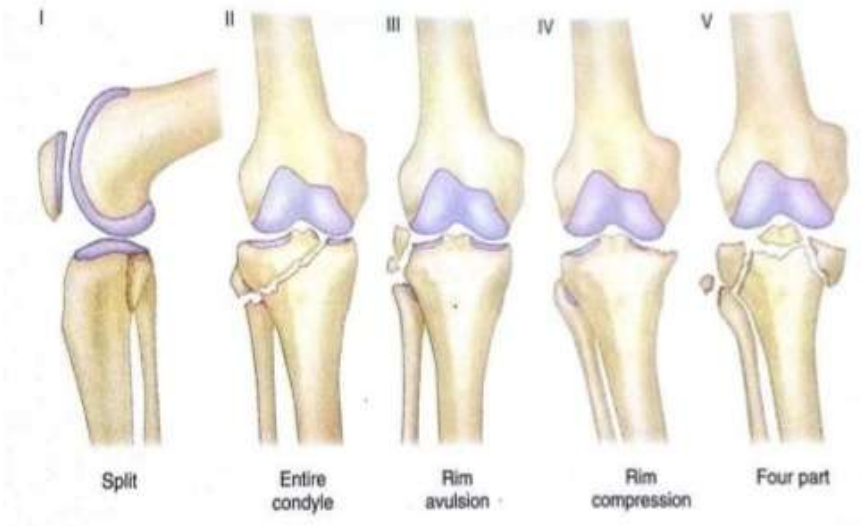


Figure :11

Fracture Pattern

Type–1: Split fractures of the lateral condyle.

Type-2: Lateral compression.

Type-3: Split with compression fracture.

Type-4: Total condylar fractures.

Type-5: Bicondylar fractures.

Fracture - Dislocation Pattern

Type-1: Coronal split fracture dislocation.

Type-2: Entire condylar fracture dislocation.

Type-3: Rim avulsion fracture dislocation.

Type-4: Rim compression fracture dislocation.

Type-5: Four-part fracture dislocation.

AO CLASSIFICATION OF TIBIAL PLATEAU FRACTURES[50]:

Type-1: Wedge fractures

Type-2: Depression fractures.

Type-3: Wedge and depression fractures.

Type -4: 'Y' and 'T' fractures/comminuted fractures of both the condyles.

THE AO CLASSIFICATION OF PROXIMAL TIBIAL FRACTURES

Type-A - Metaphyseal fractures that do not involve the joint surface.

Type-B - Partial articular fractures.

B-1 - Pure split fracture.

B-2 - Pure depression fracture.

B-3 - Split depression fracture.

Type-C - Complete articular fractures.

C-1 - Articular simple, metaphyseal simple.

C-2 - Articular simple, metaphyseal multi fragmentary.

C-3 - Articular multi fragmentary.

INVESTIGATIONS

Plain Radiograph

Anteroposterior & Lateral views usually show a plateau fracture.

In doubtful fracture 15° of AP Oblique view inclined caudally.

Traction films and stress x-rays. To assess the efficacy of an applied ligamentotaxis force.

CT Scan

Especially useful in determining the extent of injury, amount of articular depression but gives limited information about the soft tissue status. CT with leg in traction to assess ligamentotaxis.

Magnetic Resonance Imaging

Delineates status of soft tissues like ligaments, menisci and capsules. To know the amount of articular depression.

Angiography

Useful in High velocity injuries associated with vascular compromise.

MODALITIES OF TREATMENT OF TIBIAL PLATEAU FRACTURES[45]

Conservative

- Closed reduction and POP application
- Skeletal traction and mobilization
- Functional brace

Surgical

- Percutaneous screw fixation
- Open reduction and internal fixation with cancellous screws and bone grafting
- Open reduction and internal fixation with plate osteosynthesis
- Open reduction and internal fixation with plate osteosynthesis and bone grafting
- External fixator/Hybrid external fixator/ Illizarov ring fixator
- Arthroscopic assisted internal fixation
- MIPPO (Minimally Invasive Percutaneous Plate Osteosynthesis)

Buttress plate or anatomically contoured proximal tibial locking plate to be used. For fractures involving both the condyles single or double plates to be used depending upon the fracture pattern.

COMPLICATIONS

The complications occur by virtue of fracture and also after the treatment. Most of the complications are preventable. Preventive care begins with thorough examination of the injured limb. Important aspects to detect are the peripheral neurovascular injures that may accompany with the upper tibial fractures, prompt treatment of these injuries usually

takes precedence over definite fracture treatment and often prevent catastrophic complications.

A) Early Complitations:

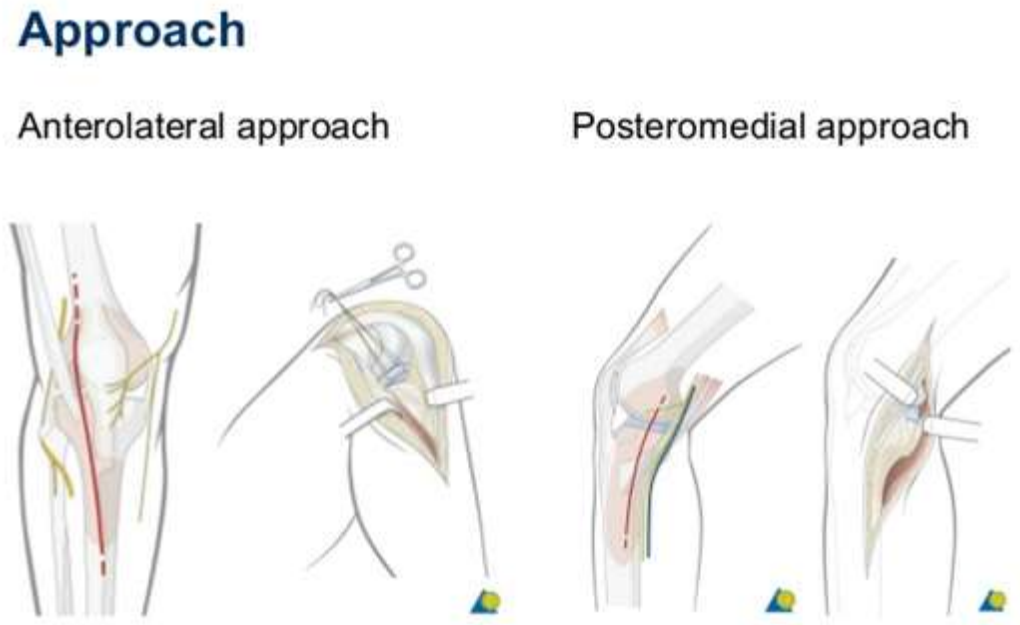
- Bleeding
- Wound infection /Dehiscence - Superficial or Deep
- Sepsis
- Compartment syndrome
- Pain
- Swelling
- Knee stiffness
- Nerve injury (Lateral popliteal. Nerve)
- Vascular Injury (Anterior tibial Artery)
- Loss of fracture reduction
- Limb length discrepancy
- Deep vein thrombosis

Late Complications

- Wound Infection
- Knee stiffness

- Malunion
- Knee instability - varus/valgus/anterior/posterior
- Extensor lag
- Angular deformities
- Persisting pain/swelling
- Redepression
- Refracture
- Delayed union
- Non-union

SURGICAL APPROACHES[51]



There are about 6 surgical approaches in tibial plateau fracture of which, most commonly used ones are the anterolateral and posteromedial incisions depending on the lateral or medial plateau respectively. Precautions that need to be taken while dealing with lateral plateau approach is not to go more posterior as there is likely injury to lateral popliteal nerve and in addition, tibialis anterior needs to be elevated subperiosteally in toto from its attachment rather than splitting into fibers.

Even in bicondylar fracture dual plating by open methods is not advised now-a-days because of likely complication of wound dehiscence. In such cases the approach should be on the side at which it is more comminuted or depressed and the intact soft tissue. Two incisions over the knee joint are not advocated, if so the minimum distance between them should be 5-7cm. Direct posterior or posteromedial approach is used in coronal fractures; the incidence of such fracture is very rare.

In all the cases periosteum should be elevated as minimal as possible, in doubtful cases, joint needs to be opened and articular surface to be viewed. Before fixing the plate with screws the wound is checked for approximation without tension or else the incision has to be modified.

METHODS AND MATERIALS

STUDY CENTRE

Institute of Orthopaedics & Traumatology, Madras Medical College and Rajiv Gandhi Government General Hospital, Chennai

DURATION OF THE STUDY

24 months

STUDY DESIGN

Prospective Study

SAMPLE SIZE

20 patients

INCLUSION CRITERIA

All type tibial plateau fractures managed operatively.

EXCLUSION CRITERIA

Tibial plateau fractures managed conservatively.

DATA COLLECTION AND METHODS

Patients are subjected to history taking, clinical examination, Radiographs, CT and MRI for evaluation if needed.

METHODOLOGY

Patients with tibial plateau fractures planned for surgery-arthroscopy assisted

1) Pre-and post operative x rays.

2) Computerised Tomography study with 3D reconstruction

3) Arthroscopy prereduction to see for soft tissue injury

4) Reduction of the fracture after release the soft tissues.

5) Arthroscopy post reduction to see for joint reduction.

STUDY PROTOCOL

Patient admitted to RGGGH with any type of Closed Tibial plateau fractures

↓

Clinical history and examination

↓

Treatment as per ATLS guidelines

↓

X Ray and CT scan

↓

All patients with all schatzker type were included in the study

↓

Demographic and injury data was recorded for the patients included in the study

↓

Above knee slab or Calcaneal pin traction is applied until the patient is fit for surgery

↓

Arthroscopy was done

↓

Findings were recorded

↓

Acceptable Reduction achieved with help of C Arm and Articular reduction verified under arthroscopic guideness

↓

Lateral / medial / both column Plating was done

↓

Post-operative X ray

↓

Follow-up and recording of outcome data

Table-1: Modified Rasmussen criteria for Clinical assessment

Pain	Points
None	6
Occasional	5
Stabbing pain in certain positions	3
Constant pain after activity	1
Significant rest pain	–3
Walking capacity	
Normal walking capacity for age	6
Walking outdoors (>1 h)	5
Walking outdoors (15 min–1 h)	3
Walking outdoors (<15 min)	1
Walking indoors only	0
Wheelchair/bedridden	–3
Knee extension	
Normal	4
Lack of extension (<10°)	2
Lack of extension (>10°)	0
Lack of extension (>20°)	–2
Total range of motion	
Full	6
At least 120°	5
At least 90°	3
At least 60°	1
<60°	–3
Stability	
Normal stability in extension and 20° flexion	6
Abnormal stability in 20° flexion	4
Instability in extension (<10°)	2
Instability in extension (>10°)	0
Power of quadriceps	
Grade 5	2
Grade 3–4	1
Grade <3	2
Maximum score	30
Excellent	28–30
Good	24–27
Fair	20–23
Poor	<20

Table 2 Modified Rasmussen criteria for radiological assessment

Articular depression	Points
None	3
<5 mm	2
6–10 mm	1
>10 mm	0
Condylar widening	
None	3
<5 mm	2
6–10 mm	1
>10 mm	0
Varus/valgus angulation	
None	3
<10°	2
10–20°	1
>20°	0
Osteoarthritis	
None/no progress	1
Progression by 1 grade	0
Progression by >1 grade	–1
Maximum score	
Excellent	9–10
Good	7–8
Fair	5–6
Poor	<5

RESULTS

We had 18 patients in our study with tibial plateau fractures admitted at Rajiv Gandhi Government general hospital Chennai. All the patients were treated with arthroscopy assisted tibial plateau fixation. The longest follow-up was 18 months and shortest follow-up period was 6 months. Mean follow-up period was 14 months. Follow-up scoring was made using Modified Rasmussen's clinical and Radiological Criteria.

In our study, most of the patients (6numbers (33.3%)) were in age group of 50-59 years.15 patients (86.6%)were males and 3 patients (13.4%) were females

10 patients got affected in the Right side (55.5%) which is more when compared to left side (44.5%)

All patients sustained injury due to Road Traffic Accident (100%). 7 patients had type V tibial plateau fractures as per Schatzker classification (38.8%)is the most common type in our study.

In our study 2 patients (11.1%) had type I,3 (16.7%) patients had type II,3 (16.7%) patients had had type IV ,7 patients (38.8%) had type V ,3 patients (16.7%) had type VI as per Schatzker classification of tibial plateau fractures. There were no Type III fracture.

Associated injuries were 1 patient had shaft of femur fracture same side, 1 patient had distal radius extraarticular fracture,1 patient had ipsilateral side T Type Acetabulum fracture.

2 patients were diabetic, 1 patient had previous history of coronary heart disease and one patient had congenital diaphragmatic hernia Average delay for surgery was 20.5 days (Range 7 to 60 days).

3 patients had articular depression and 4 patients had meniscus entrapment which was released arthroscopically. There were No other ligamentous and meniscal injuries.

Autologous bone grafting from iliac crest was used in 3 cases of type II and 1 case of type 4 through a lateral cortical window tibial plateau fractures cases for elevating the depression (mean 8mm range from 6mm-10mm) of the articular surface. We didn't use bone grafts in other type tibial plateau cases.

In 3 patients (16.7%) we did medial column tibial plating, 5 (27.8%)patients we did lateral column tibial plating,2 patients (11.1%) lateral plating with mediolateral cancellous screws,3 patients (16.6%) cancellous screws alone and in 5 (27.8%) patients we did Bi column plating.

Postoperatively none of our patients in our series developed thromboembolism.

Weight bearing started on 6 to 8 weeks in all the patients

A total of 17 patients were available for final evaluation of final outcome.

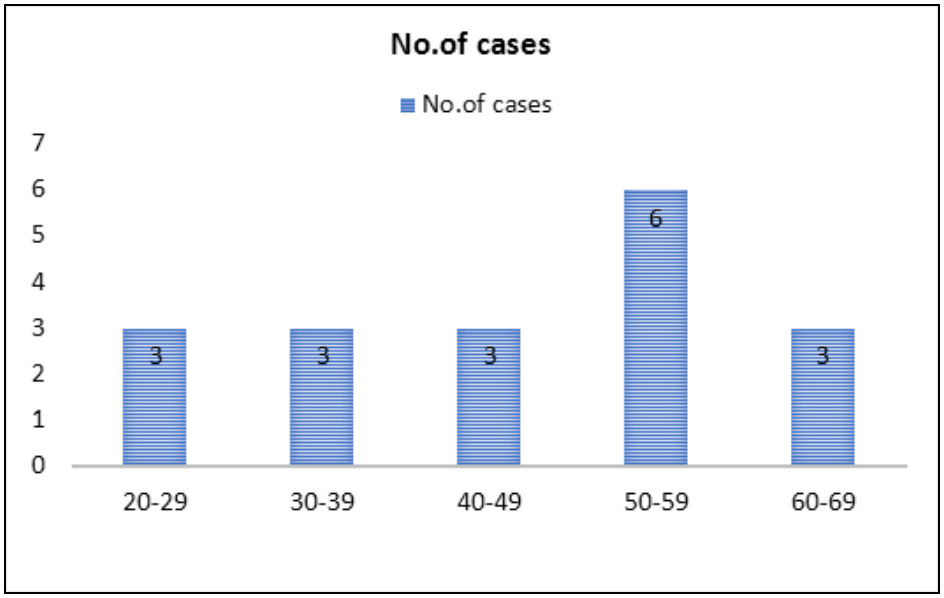
According to Modified Rasmussen criteria Clinical assessment in our study,11 (61.1%) patients had excellent outcome,1(5.5%) patients had fair outcome,3 (16.6%) had poor outcome. No patients had good outcome.

According to Radiological assessment of the same criteria 11(64.7%) patients had excellent outcome,3(17.6%) had good outcome,3(17.6%) percent had fair outcome. No patients had poor outcome.

In our study 4(22.2%) patients developed wound infection postoperatively.1(5.5%) patient went against medical advice and it was considered lost follow-up. Remaining three patients had superficial infection who are treated with antibiotics for 6 weeks, wound wash and debridement. They didn't require any further plastic surgery procedure. Due to persistent deep infection implant exit was done for 1 patient (5.5%). Two patients (11.7%) developed varus deformity which was not affecting the daily living life.

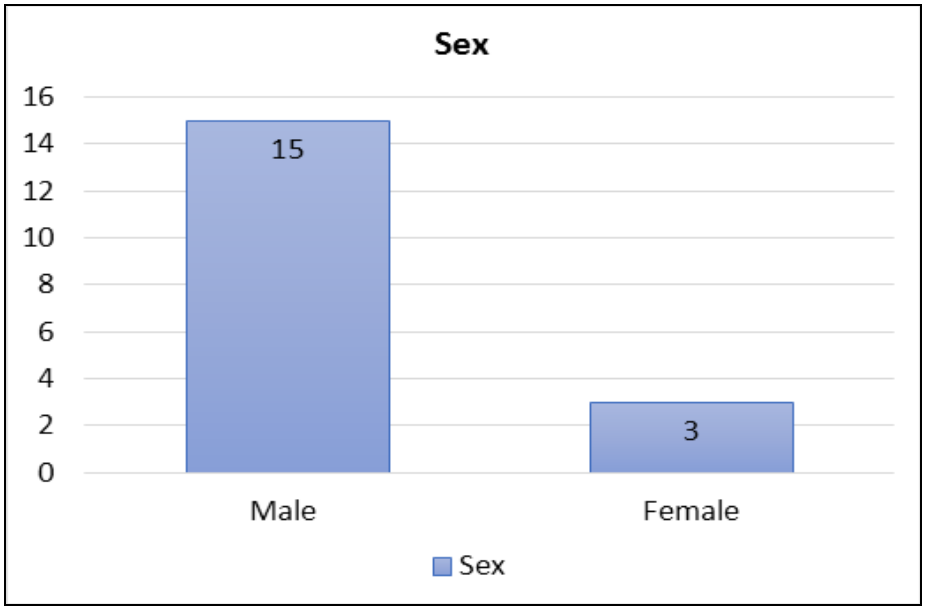
AGE INCIDENCE

Most common age group in our study is 50to 59 years (33.3%).



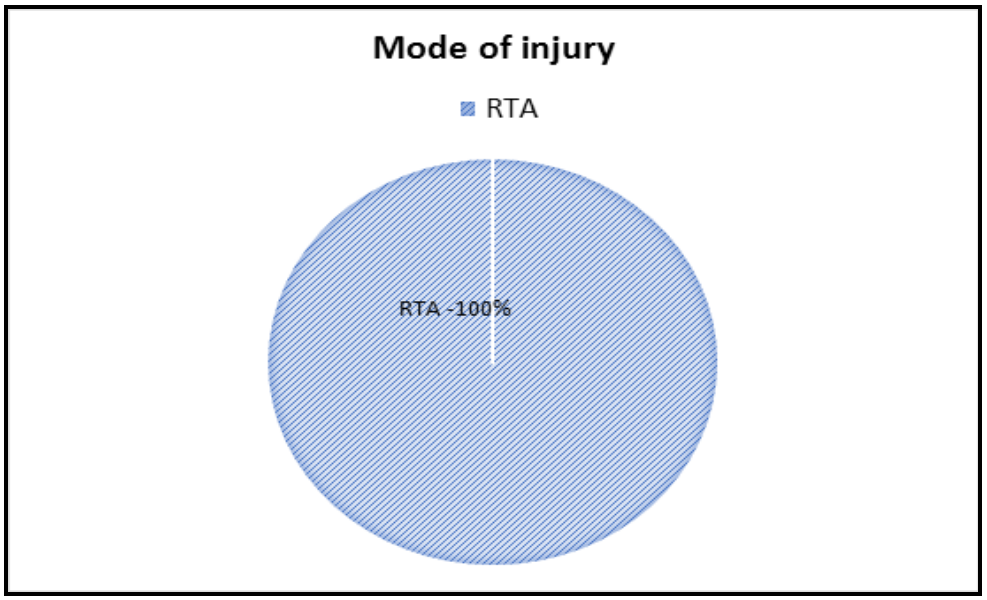
SEX INCIDENCE

In our study males (86.6%) are more affected then females (13.4%).



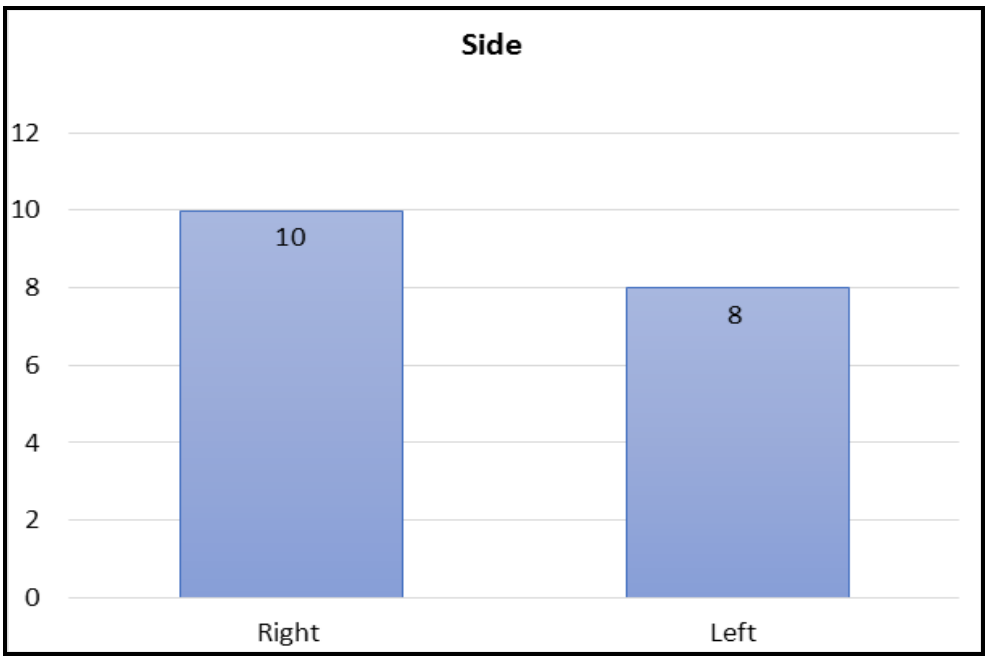
MODE OF INJURY

All patients in our study got injured by Road traffic accident (100%).



SIDE OF INJURY

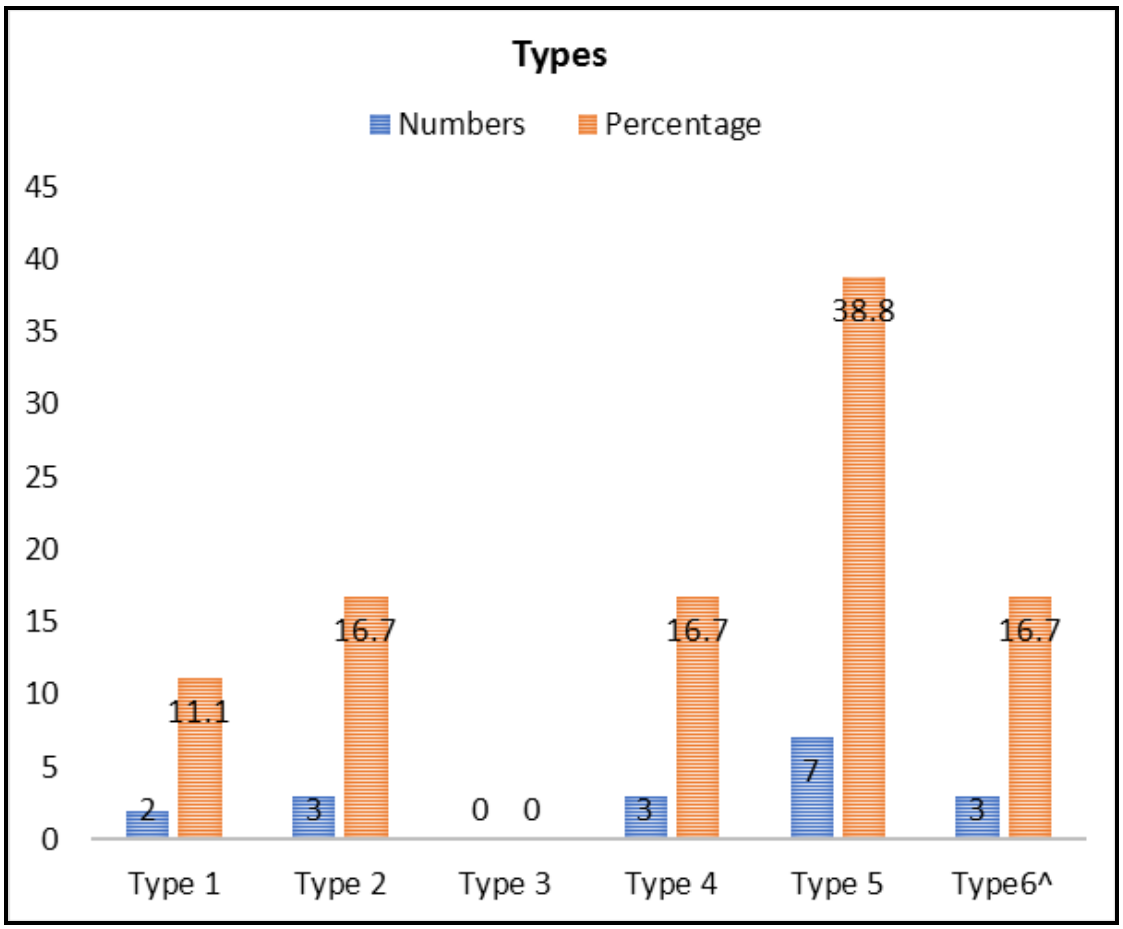
Right side (55.5%)is more affected then the left side (45.5%).



Right side (55.5%) is more affected then the left side (44.5%).

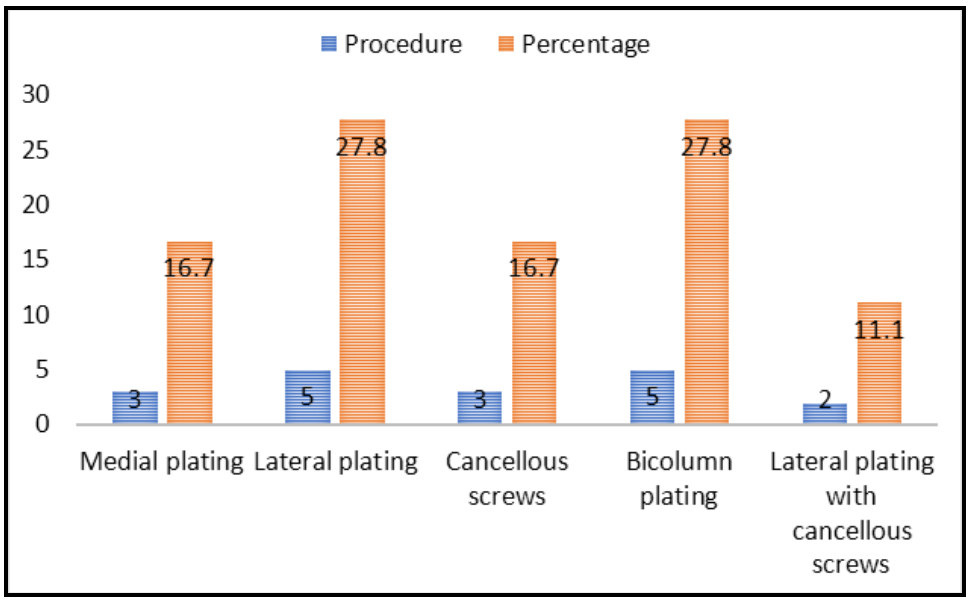
TYPES AS PER SCHATZKER CLASSIFICATION:

Most common type of fracture is Type V (38.8%).



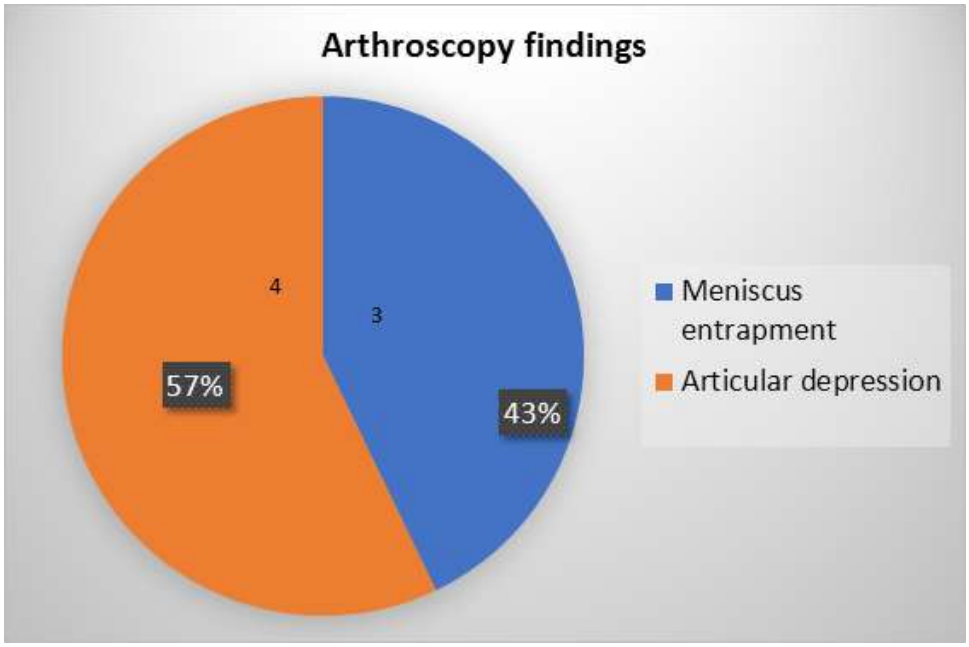
PROCEDURE DONE

Lateral plating was done in 27.8% of cases.

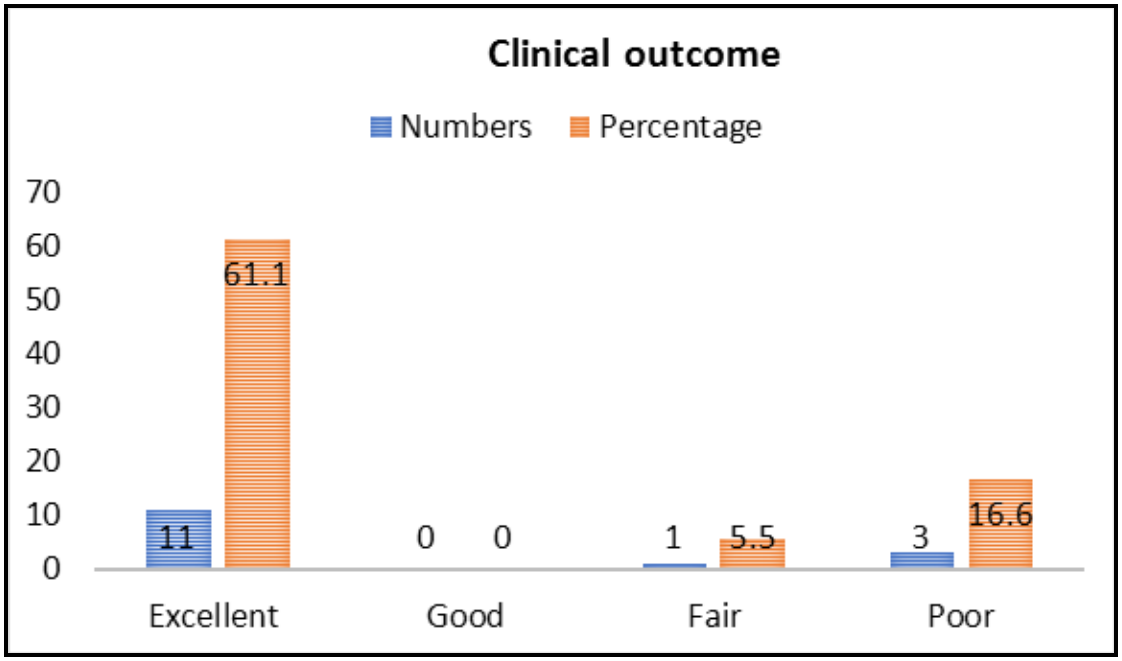


INTRA OPERATIVE ARTHROSCOPY FINDINGS

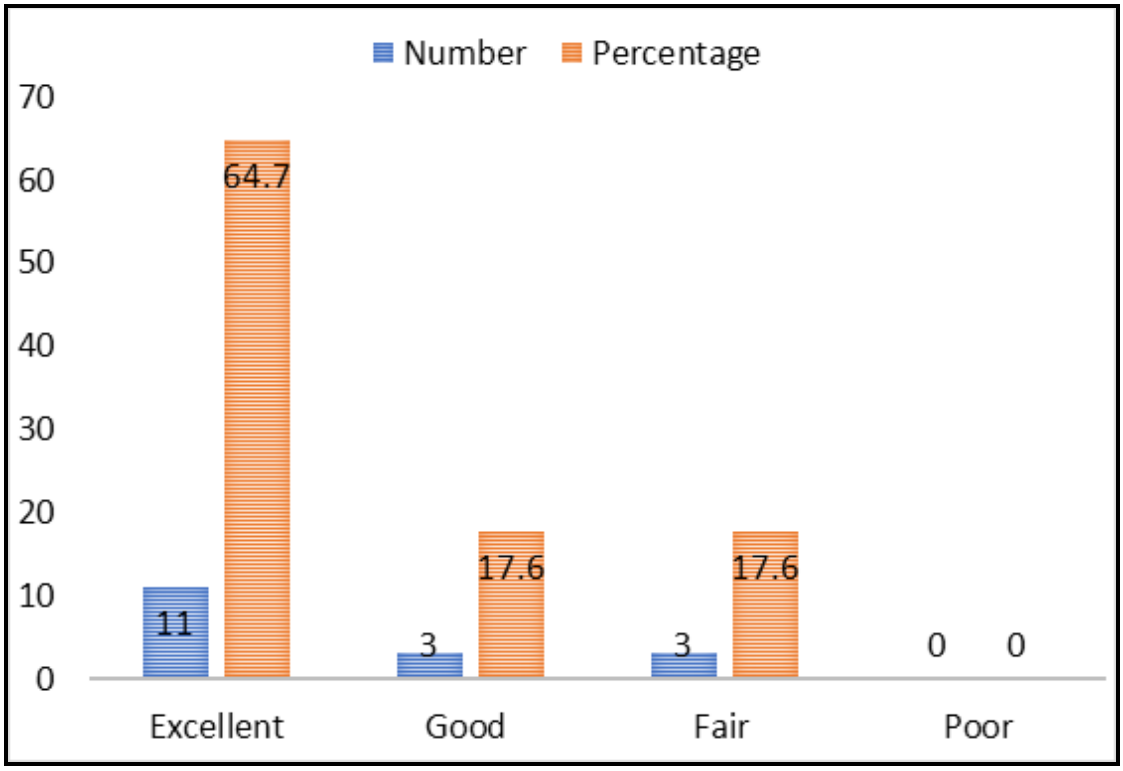
Among 15 patients 3 patients had meniscus entrapment which was released arthroscopically.



OVERALL CLINICAL OUTCOME:

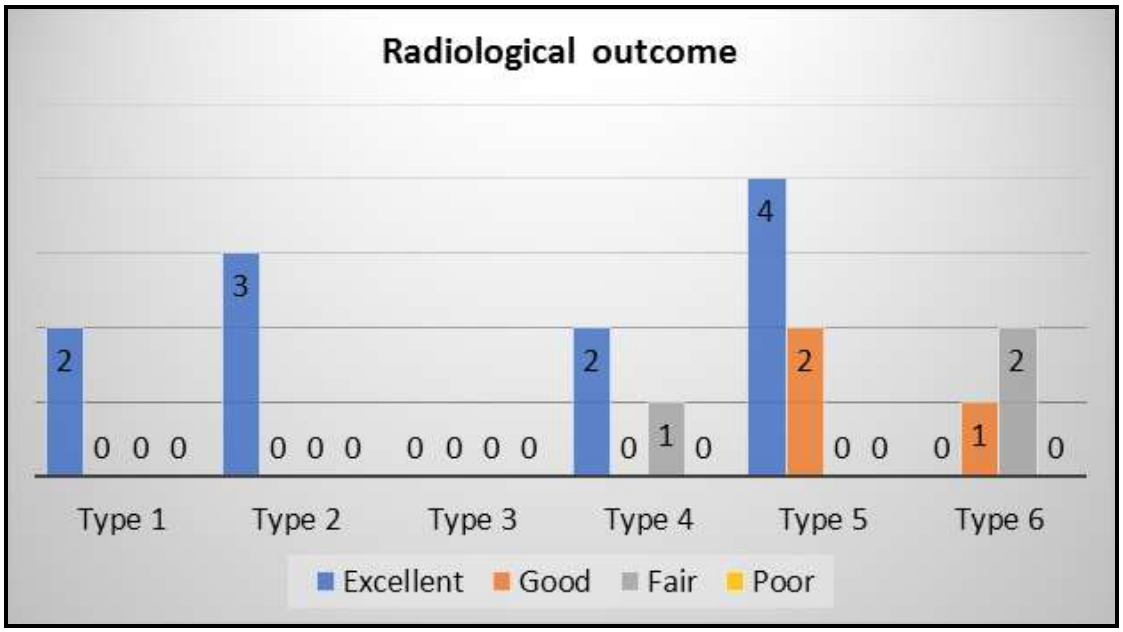


OVERALL RADIOLOGICAL OUTCOME

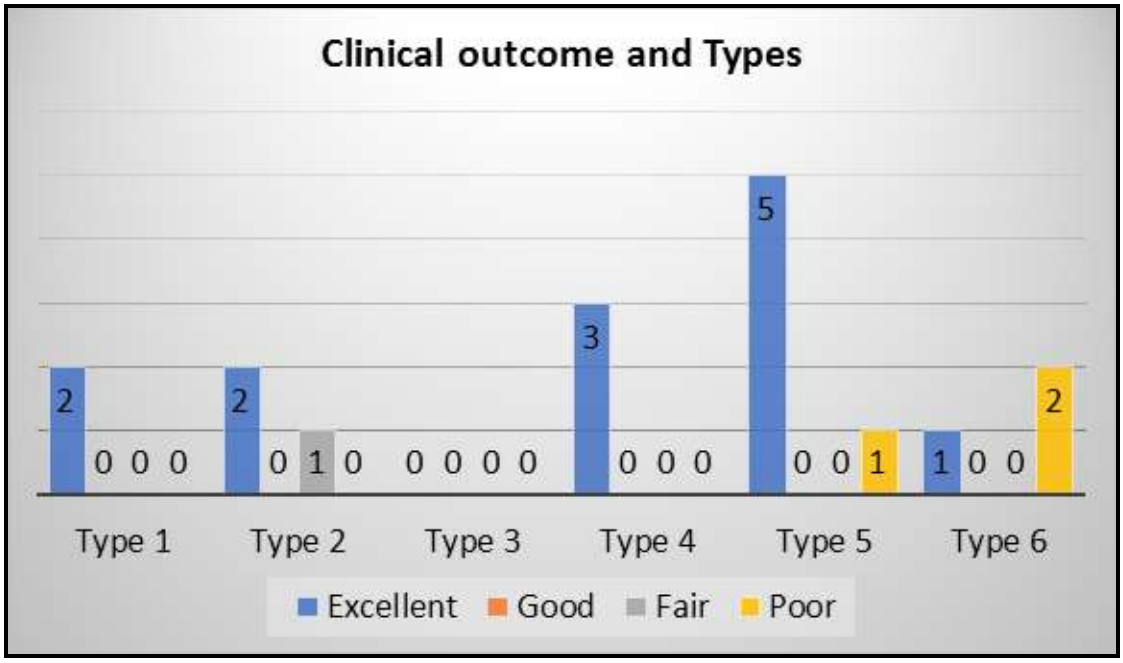


INDIVIDUAL TYPE RADIOLOGICAL OUTCOME

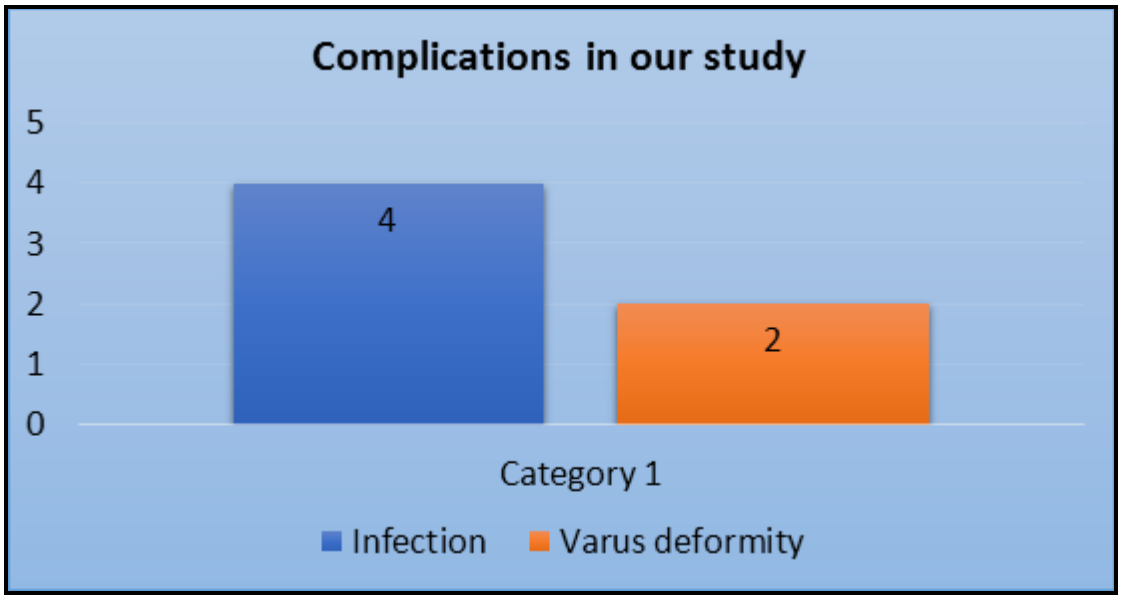
In our study we had fair radiological outcome in 2 cases of type VI tibial plateau fracture which is statically significant ($p<0.02$) and in one case of type II tibial plateau fracture



INDIVIDUAL TYPE CLINICAL OUTCOME



COMPLICATIONS IN OUR STUDY



DISCUSSION

Tibial Plateau fractures are intra-articular fractures occurring due to various means like RTA, Fall from height, Violence etc. In our study, the commonest mode of injury was found to be RTA (100%). Its management remains a subject of debate owing to their complexity. There are various fixation methods for these fractures. An ideal method with better outcome is a matter of debate among orthopedic surgeons.

In our study clinical and radiological outcome of Schatzker Type I to Type VI Tibial plateau fractures treated by Arthroscopy assisted fixation in 18 cases were analyzed using Modified Rasmussen criteria for clinical and Radiological outcome.

Conservative management of tibial plateau fractures cannot reduce displaced and depressed fractures. It is very important to adequately see the amount of depression, visualize the fracture reduction and elevation of the depression, thereby regaining the articular congruity and obtain a stable semi rigid internal fixation. In tibial plateau fracture, restoring the articular congruity and preventing laxity of the knee are most important predictors of proper knee function. Anatomical reduction of knee joint is important for better outcome on long term basis. Disadvantages of Open Reduction and Internal Fixation for tibial plateau fracture are arthrotomy and transection of the meniscus which

lead onto stiffness, Proprioception disorders, Severe postoperative pain and wound complications because of extreme dissection of soft tissues. Arthroscopy assisted Internal fixation has various advantages which includes direct visualization of Articular reduction, Soft tissue repair if present and minimal invasiveness. Advanced experience in arthroscopy is needed for clear visualization with arthroscope which is needed for fracture reduction. Arthroscope allows thorough debridement of knee joint, lavage and evacuation of fracture hematoma. [8]

In this Study, Tibial plateau fractures were more commonly seen in 50to 59 years due to RTA. It is very important to visualize the articular reduction to obtain stable fracture fixation. Anatomic reduction is more important in Younger patients because of the higher functional demands placed on to the knee and longer time they take to develop arthritis.

In our series majority of patients were male (86.6%) as they were involved mostly in RTA due to their outdoor occupation. In our series right side (55.5%) is more commonly affected than the left side (45.5%)

In our study 4(22.2%) patients developed wound infection postoperatively.1(5.5%) patient went against medical advice and it was considered lost follow-up.3 patients had superficial infection who was treated with antibiotics for 6 weeks, wound wash and debridement. They didn’t require any further plastic surgery procedure. Due to persistent

deep infection implant exit was done for 1 patient (5.5%). 2 patients fixed with lateral column plating and mediolateral cancellous screws who developed varus deformity in the follow-up had Schatzker Type VI tibial plateau fracture. Reason for varus deformity is probably inadequate medial column fixation in the retrospect bicolumn plating would have been the better option.

In a Study by Roerdink et. al[52]. 80% of the patients were with Clinical Rasmussen score Excellent or good. Arthroscopy Assisted Tibial plateau fracture fixation help in complete evaluation of the Associated soft tissue injury in the knee and their treatment during the same surgery. Meniscal tears were noted in 42.7 % of all tibial plateau fractures. Most common types were peripheral and radial tears. 21.3 % of ACL injuries were with Schatzker Type IV & VI fractures. In our study we encountered only meniscal entrapment and there was no meniscal injury.

Outcome assessment for soft tissue injuries was beyond the scope of our study since it was a short period study.

Benea H et. al.[53] which included Shatzker Type I to Type VI fractures showed excellent results(assessed by Rasmussen score) in 5 cases and good in one case. In our study we had 5 cases of Schatzker Type I and Type II In which four had excellent outcome and 1 had good outcome.

Various studies have shown the use of bone grafts ranging 11.1% to 100%.[53]in our study Autologous bone grafting from iliac crest was used in 3 cases of Schatzker type II and 1 case of type 4 through a lateral cortical window tibial plateau fractures cases for elevating the depression (mean 8mm range from 6mm-10mm)of the articular surface.

Various studies used Rasmussen scoring system and Ahlback scale for evaluating the radiological outcome. We used modified radiological Rasmussen Scoring. They showed that depression of no less than 2 mm was considered a displacement postoperatively and occurred in 30 patients. At least 9 patients had an articular depression of more than 4 mm and 25.9% of the patients presented with osteoarthritis postoperatively [53]. We had articular depression in two patients Mean of 3.5mm(3mm-4mm) postoperatively in 1 case of Schatzker type V and 1 case of Schatzker type VI. Progression of osteoarthritis couldn't be studied since it is short term outcome study.

Shen G et. al[54] showed that the fracture healing time of arthroscope group was shorter than that of control group but the difference was not significant. We did not have control group to compare the fracture healing time.

Richard B Caspari et. al. showed that in around 29 patients 2 patients had peroneal nerve palsy. We didn't encounter any peroneal nerve palsy due to extravasation of fluids and compression of nerve.

Belanger et al[56]. Showed a case of compartment syndrome in the leg postoperatively, they advised the precautions when irrigation pump is used, the pressure should not exceed 50mmHg and the calf should be monitored during the procedure. However, in our study we did not face any Compartment syndrome.

Even in type V and Type IV cases we didn't have any compartment syndrome and the probable the reason could be that the interval from time of injury to time of surgery is longer and the soft tissue compartment is healed which didn't allow the extravasation of fluid.

Average delay for surgery was a mean of 20.5 days (7 days to 60 days). Due to delay and prolonged immobilization Schatzker type V and Type VI (10 patients) tibial plateau fracture developed arthrofibrosis for whom it was difficult to do arthroscopy and arthrofibrosis is removed with shaver and further evaluation was done.

In a study by Hung SS et. al[57]., Chan et. al. Buchko GM et. al[58]., Brenfeld GM et. al[59] showed deep infection s in cases operated with Arthroscopy assisted techniques. We faced 4 infections for whom we did Wound debridement, Wound Wash and antibiotics and for 1 patient who had persistent infection, implant exit was done after 9 months.

In our study 2 patients developed varus deformity (15 degrees) which doesn't affect their daily living activity.

In various studies it was pointed out that significant joint space narrowing was found in 10% to 30 % of patients followed up for 3 years [60]. Our study is a short term study with a maximum follow up of 20 months we didn't encounter any joint space narrowing on x ray.

In more complex tibial plateau fractures medial side patterns, it is preferred to use two approaches to avoid varus collapse or in accurate medial reduction [62]. We used lateral column plating and mediolateral cancellous screws for 2 cases of Schatzker type VI tibial plateau fractures which led on to varus collapse and varus deformity in the follow-up. It is preferable to use bicolumn plating in these cases.

Arthroscopic Assisted tibial plateau fracture fixation is a technically demanding procedure and requires a long learning curve.

Dall'oca C et al[63] who compared the outcomes between Arthroscopic assisted fixation and Open reduction internal fixation suggests that there is no difference between these two treatments in Schatzker type I fractures. Arthroscopy assisted fixation may increase the outcome in Schatzker type II-III-IV fractures. In Schatzker Type V and VI fractures, both techniques have both poor medium and long-term

results, but they indicated Arthroscopic assisted treatment is best choice for the lower rate of infections.

Wang Z et al[64] who also compared the outcome of Arthroscopy assisted and Open reduction internal fixation methods they found that Both this method gave satisfactory clinical results for the treatment of the Schatzker I-IV tibial plateau fractures. Arthroscopy assisted technique led to better radiological results than open reduction and internal fixation techniques and concomitant soft tissue lesions can be addressed during Arthroscopy.

Our study is not the comparative study between arthroscopy assisted fixation and open reduction internal fixation to compare the outcomes between two groups. But we had excellent outcome in eleven cases of Schatzker type I-V tibial plateau fractures

Hung et. al(56) reported excellent and good results for arthroscopic assisted fixation of tibial plateau fractures ranging from 85% - 90%.

Chan . al on the basis of Rasmussen scoring system showed Satisfactory, good to excellent results in 96% cases at 2 – 10-years follow-up.

Chiu et. al.(55) reported 92 % patients showed excellent clinical and radiological results according to Rasmussen score.

In spite of complications associated with Tibial plateau fractures and management using arthroscope assisted tibial plateau fixation, clinically 11 (61.1%) patients had excellent outcome,1(5.5%) patients had fair outcome,3 (16.6%) had poor outcome.

Clinical poor outcome was because we failed to support the medial column with plate in Schatzker type VI fractures.

LIMITATIONS OF OUR STUDY

- Short term follow up,
- Failure to achieve target sample size of 20.
- Loss of follow-up of 5.5%.
- Our study is not the comparative study
- Surgery done by different surgeons
- All fractures included in the study were caused by Road Traffic Accidents.

CONCLUSION

Arthroscopic evaluation of fracture reduction without an extensive arthrotomy incision and also enables optimal treatment of concomitant lesions.

In complex tibial plateau fractures, the use of arthroscopy by an experienced surgeon can minimize the surgical trauma.

Arthroscopic assisted fixation of tibial plateau fractures is a reliable and safe method for the treatment of tibial plateau fractures, especially when they present with concomitant injuries.

This study found excellent to good results as per Modified Rasmussen’s clinical and radiological score at short term follow in all Schatzker types of tibial plateau fractures.

CASE-1

Pre-Op X-Ray

Pre-Op CT

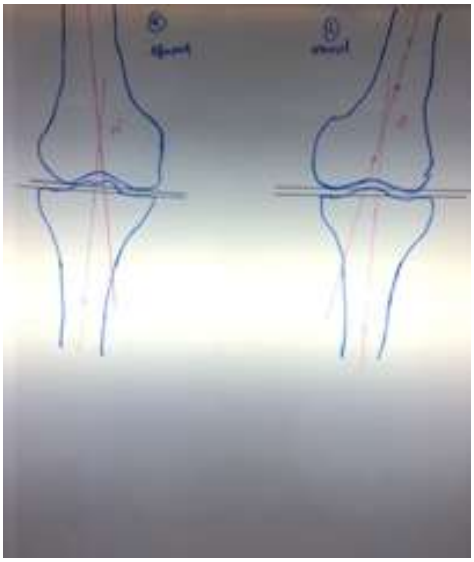
Intraoperative Arthroscopy-Op X-Ray

Immediate POst Op

Clinical Outcome

Clinical Outcome

Radiological outcome



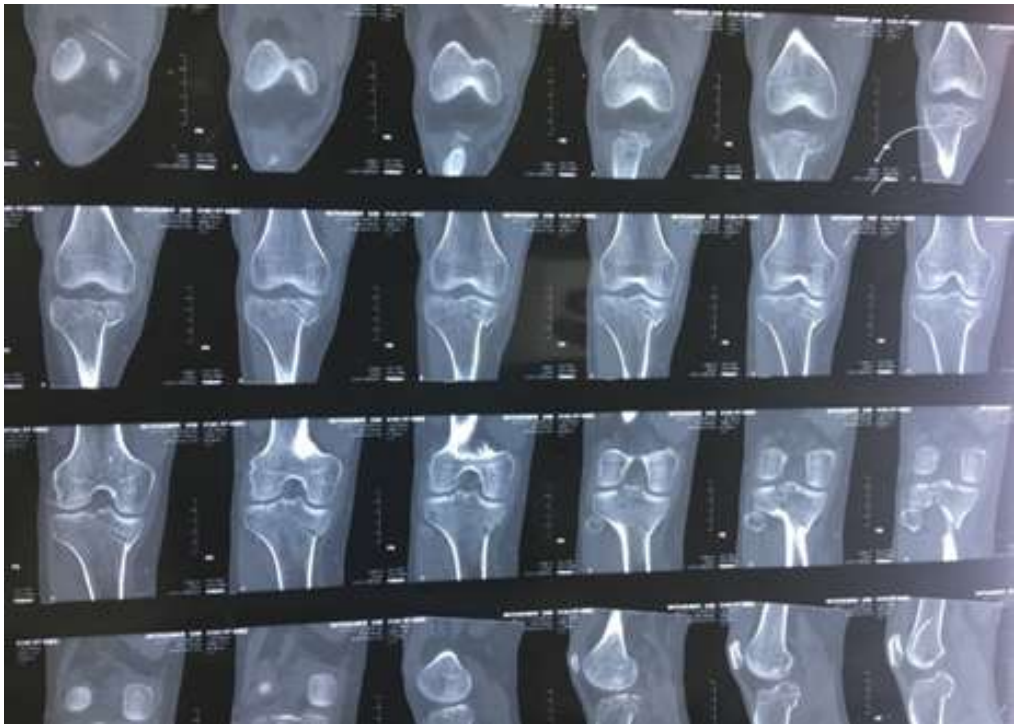
Valgus (10 degrees equal to opposite side)

Condylar widening (Equal on both sides)

CASE-2

Pre Op X-Ray

Pre op CT



Intraoperative arthroscopy

Post-Op X-Ray

3 months clinical pictures

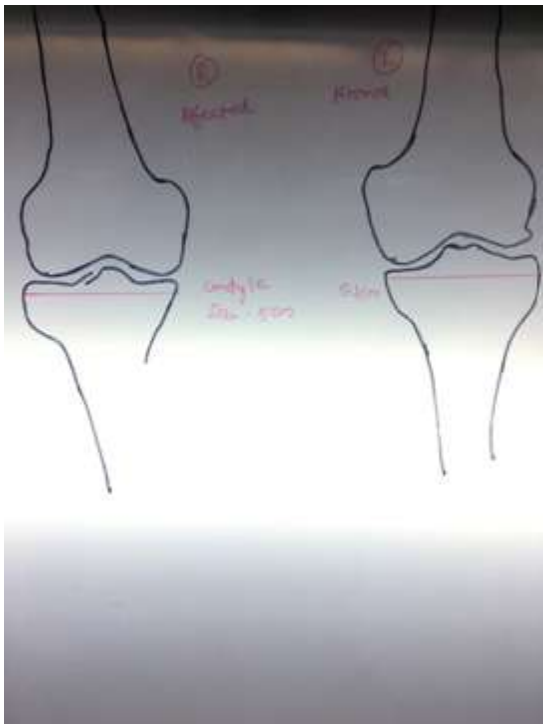
5 Months and Six MonthPost-Op X-Ray

One and half year clinical outcome Scar picture

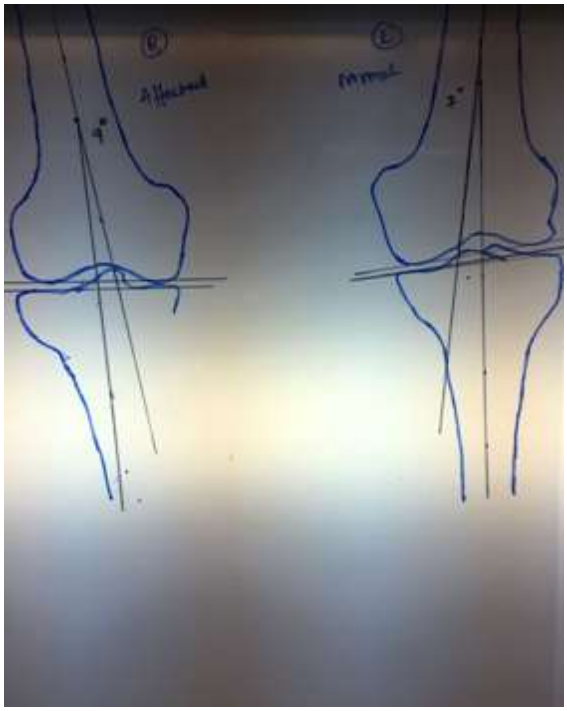
1 ½ Year Follow Up clinical outcome

One and half year clinical outcome

Radiological outcome



(Condylar widening) 0.2cm less than the normal side affected side



Valgus angle 9 degree

CASE-3

Pre op X ray

Intraop Arthroscopy

Immediate post op x ray

6 months followup

Clinical outcome(1year follow-up)

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65) Research analysis wing, Institute of Orthopaedics ana Traumatology (**IOT RAW)**

PROFORMA

Age:

Sex:

Address:

I.P. No.:

Unit:

D.O.A:

D.O.S:

Ward:

Mode of Injury:

Side Of Injury:

Associated Injuries:

Schatzker Classification:

- Hb, Sugar, Urea, Creatinine
- ECG
- Plain X-Ray Knee-AP and Lateral Views.
- CT Knee- Axial,Coronal,Sagittal And 3D reconstruction Views.
- MRI

Investigations:

Informed Written Consent:

Surgery:

- Interval between injury and Surgery
- Anaesthesia
- Position
- Implants
- Approach
- Operative time and Blood Loss

Intra-op Findings:

Post-Operative

- Physiotherapy

Complications:

- Infection-Early/Late
- Wound Dehiscense
- Knee Stiffness

Range of Movements:

- Flexion:
- Extension:

Follow up:

- Radiological Assessment: X-Ray Knee- AP and Lateral Views.
  Day 2: 6 Weeks: 3 Months: 6 Months:
  Modified Rasmussen's Radiological Criteria:
- Functional Assessment:
  Modified rasmussen's Clinical Criteria:
- Wound Status

Modified Rasmussen criteria for Clinical assessment

Pain	Points
None	6
Occasional	5
Stabbing pain in certain positions	3
Constant pain after activity	1
Significant rest pain	–3
Walking capacity	
Normal walking capacity for age	6
Walking outdoors (>1 h)	5
Walking outdoors (15 min–1 h)	3
Walking outdoors (<15 min)	1
Walking indoors only	0
Wheelchair/bedridden	–3
Knee extension	
Normal	4
Lack of extension (<10°)	2
Lack of extension (>10°)	0
Lack of extension (>20°)	–2
Total range of motion	
Full	6
At least 120°	5
At least 90°	3
At least 60°	1
<60°	–3
Stability	
Normal stability in extension and 20° flexion	6
Abnormal stability in 20° flexion	4
Instability in extension (<10°)	2
Instability in extension (>10°)	0
Power of quadriceps	
Grade 5	2
Grade 3–4	1
Grade <3	2
Maximum score	30
Excellent	28–30
Good	24–27
Fair	20–23
Poor	<20

Modified Rasmussen criteria for radiological assessment

Articular depression	Points
None	3
<5 mm	2
6–10 mm	1
>10 mm	0
Condylar widening	
None	3
<5 mm	2
6–10 mm	1
>10 mm	0
Varus/valgus angulation	
None	3
<10°	2
10–20°	1
>20°	0
Osteoarthritis	
None/no progress	1
Progression by 1 grade	0
Progression by >1 grade	−1
Maximum score	
Excellent	9–10
Good	7–8
Fair	5–6
Poor	<5

ஒப்புதல் படிவம்

தலைப்பு: Analysis of results and outcome of arthroscopy (**ஆர்த்ரோஸ்கோபி**) assisted management of tibial plateau fractures

ஆராய்ச்சி மையம்: **இராஜீவ் காந்தி அரசு பொது மருத்துவமனை மற்றும் மருத்துவக் கல்லூரி, சென்னை.**

நோயாளியின் பெயர்: நோயாளியின் வயது:

பதிவு எண்:

நோயாளி கீழ்கண்டவற்றுள் கட்டங்களை (✓) செய்யவும்

1. மேற்குறிப்பிட்டுள்ள ஆராய்ச்சியின் நோக்கத்தையும் பயனையும் முழுவதுமாக புரிந்து கொண்டேன். மேலும் எனது அனைத்து சந்தேகங்களையும் கேட்டு அதற்கான விளக்கங்களையும் தெளிவுபடுத்திக் கொண்டேன்.
2. மேலும் இந்த ஆராய்ச்சிக்கு எனது சொந்த விருப்பத்தின் பேரில் பங்கேற்கிறேன் என்றும், மேலும் எந்த நேரத்திலும் எவ்வித முன்னறிவிப்புமின்றி இந்த ஆராய்ச்சியிலிருந்து விலக முழுமையான உரிமை உள்ளதையும், இதற்கு எவ்விட சட்ட பிணைப்பும் இல்லை என்பதையும் அறிவேன்.
3. ஆராய்ச்சியாளரோ, ஆராய்ச்சி உதவியாளரோ, ஆராய்ச்சி உபயத்தாரோ, ஆராய்ச்சி பேராசிரியரோ, ஒழுங்குநெறி செயற்குழு உறுப்பினர்களோ எப்போது வேண்டுமானாலும் எனது அனுமதியின்றி எனது உள்நோயாளி பதிவுகளை இந்த ஆராய்ச்சிக்காகவோ அல்லது எதிர்கால பிற ஆராய்ச்சிகளுக்காகவோ பயன்படுத்திக் கொள்ளலாம் என்றும், மேலும் இந்த நிபந்தனை நான் இவ்வாராய்ச்சியிலிருந்து விலகினாலும் தகும் என்றும் ஒப்புக் கொள்கிறேன். ஆயினும் எனது அடையாளம் சம்பந்தப்பட்ட எந்த பதிவுகளும் (சட்டப்பூர்வமான தேவைகள் தவிர) வெளியிடப்படமாட்டாது என்ற உறுதிமொழியின் பெயரில் இந்த ஆராய்ச்சியிலிருந்து கிடைக்கப்பெறும் முடிவுகளை வெளியிட மறுப்பு தெரிவிக்கமாட்டேன் என்று உறுதியளிக்கிறேன்
4. இந்த ஆராய்ச்சிக்கு நான் முழுமனதுடன் சம்மதிக்கிறேன் என்றும் மேலும் ஆராய்ச்சிக் குழுவினர் எனக்கு அளிக்கும் அறிவுரைகளை தவறாது பின்பற்றுவேன் என்றும் இந்த ஆராய்ச்சி காலம் முழுவதும் எனது உடல் நிலையில் ஏதேனும் மாற்றமோ அல்லது எதிர்பாராத பாதகமான விளைவோ ஏற்படுமாயின் உடனடியாக ஆராய்ச்சி குழுவினரை அணுகுவேன் என்றும் உறுதியளிக்கிறேன்.
5. இந்த ஆராய்ச்சிக்குத் தேவைப்படும் அனைத்து மருத்துவப் பரிசோதனைகளுக்கும் ஒத்துழைப்பு தருவேன் என்று உறுதியளிக்கின்றேன்.
6. இந்த ஆராய்ச்சிக்கு யாருடைய வற்புறுத்தலுமின்றி சொந்த விருப்பத்தின் பேரிலும் சுய அறிவுடனும் முழுமனதுடனும் சம்மதிக்கிறேன் என்று இதன் மூலம் ஒப்புக் கொள்கிறேன்.

நோயாளியின் கையொப்பம்/ பெருவிரல் ரேகை

ஆராய்ச்சியாளரின் கையொப்பம்

இடம்:

தேதி:

INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE, CHENNAI 600 003

EC Reg.No.ECR/270/Inst./TN/2013
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CERTIFICATE OF APPROVAL

To
Dr.Rajarajan.E.
Post Graduate in M.S.Orthopaedics
Institute of Orthopaedics & Traumatology
Madras Medical College
Chennai 600 008

Dear Dr.Rajarajan.E,

The Institutional Ethics Committee has considered your request and approved your study titled **"ANALYSIS OF RESULTS AND OUTCOME OF ARTHROSCOPY ASSISTED MANAGEMENT OF TIBIAL PLATEAU FRACTURES" NO. 25122016.**

The following members of Ethics Committee were present in the meeting hold on **14.12.2016** conducted at Madras Medical College, Chennai 3

1.Dr.C.Rajendran, MD.,	:Chairperson
2.Dr.M.K.Muralidharan,MS.,M.Ch.,Dean, MMC,Ch-3	:Deputy Chairperson
3.Prof.Sudha Seshayyan,MD., Vice Principal,MMC,Ch-3	: Member Secretary
4.Prof.B.Vasanthi,MD., Prof.of Pharmacology.,MMC,Ch-3	: Member
5.Prof.A.Rajendran,MS, Prof. of Surgery,MMC,Ch-3	: Member
6.Prof.N.Gopalakrishnan,MD,Director,Inst.of Nephrology,MMC,Ch	: Member
7.Prof.Baby Vasumathi,MD.,Director, Inst. of O & G	: Member
8.Prof.K.Ramadevi,MD.,Director,Inst.of Bio-Che,MMC,Ch-3	: Member
9.Prof.R.Padmavathy, MD, Director,Inst.of Pathology,MMC,Ch-3	: Member
10.Prof.S.Mayilvahanan,MD,Director, Inst. of Int.Med,MMC, Ch-3	: Member
11.Tmt.J.Rajalakshmi, JAO,MMC, Ch-3	: Lay Person
12.Thiru S.Govindasamy, BA.,BL,High Court,Chennai	: Lawyer
13.Tmt.Arnold Saulina, MA.,MSW.,	:Social Scientist

We approve the proposal to be conducted in its presented form.

The Institutional Ethics Committee expects to be informed about the progress of the study and SAE occurring in the course of the study, any changes in the protocol and patients information/informed consent and asks to be provided a copy of the final report.

19/1/17

Member Secretary, Ethics Committee

MEMBER SECRETARY
INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE
CHENNAI-600 003

URKUND

Urkund Analysis Result

Analysed Document:	ANALYSIS OF RESULTS AND OUTCOME OF ARTHROSCOPIC ASSISTED MANAGEMENT OF TIBIAL PLATEAU FRACTURES.pdf (D31694843)
Submitted:	10/26/2017 4:44:00 AM
Submitted By:	rajarajan.elumalai@gmail.com
Significance:	2 %

Sources included in the report:

dissertation.docx (D30941404)
THESIS - Copy.docx (D30255337)
finalised thesis.docx (D31609314)

Instances where selected sources appear:

8

S no	Name Age / Sex, IP No	Mode of injury	Diagnosis	Skin condition	Procedure done	Co morbity	Intraop findings
1	Anbalazhan 35/M 92266/16 TR8218	Self Fall from Bike	Type V tibial plateau fracture left	Normal	Medial palting	No	Normal
2	Prasanth 20/M 97998 3*	RTA(2 wheeler Vs 2 wheeler)	Type I tibial plateau fractureleft	Normal	Lateral plating	No	Normal
3	Duraisamy 35/M 17001 1* TR9241	Self fall from bike	Type IV tibial plateau fractureright	Normal	Cancellous screws	No	Normal Articular depression
4	Chengalvarayan 53/M 15597TR9827	Pedestrian vs Two wheeler	Type II tibial plateau fractureleft	Normal	Cancellous screws	No	Normal
5	Raja42/M 106703 TR8647	Self fall from bike	Type II tibial plateau fracture	Normal	Lateral plating	No	Meniscus entrapped
6	Velu 58/M 38833 TR10423	Pedestrian Vs two wheeler	Type V tibial plateau fracture	Normal	Lateral plating with mediolateral cancellous screw	No	Articular depression
7	Sasikala 28/F 27866 TR10896	Pedestrian Vs four wheeler	Type IV tibial plateau fracture	Normal	Lateral plating	Diapharmatic hernia	
8	Muthukumar 30/M5410 TR9526 2*	Self fall	Type V tibial plateau frature	Normal	Lateral plating	No	Normal
9	Selvi 45/M 38442TR11171	Self fall from bike	Type I tibial plateau fracture	Normal	Lateral plating	No	Normal
10	Gopi 20/M 59289 TR11247	2wheeler vs 2 wheeler	Type IV tibial plateau fracture	Normal	Cancellous screws	No	
11	Kuppapitchai 58/M50965TR11388	2 wheeler Vs 4 wheeler	Type V tibial plateau fracture	Blebs present	Both column plating	Diabetic	Meniscus entrapped
12	Selvaraj 63/M 65869TR11536	2 wheeler Vs 2 wheeler	Type VI tibial plateau fracture	Normal	Both column plating	No	Normal
13	sankaranarayan 60/M TR10235	pedestrain vs 2 wheeler	type VI	normal	Lateral plating with mediolateral cancellous screw	diabetic	meniscus injury
14	Annadurai 50/M 83400 TR11860	2 wheeler Vs 2 wheeler	Type V tibial plateau frature	Normal	Lateral plating	Normal	Normal
15	Jeyachandran 63/M 84430TR12253	4 wheeler Vs 2 wheeler	Type V tibial plateau frature	Blebs Present	Bicolumn Plating	Normal	Normal
16	Prince 52/m106323TR12305	2 wheelers vs 4 wheelr	type VI tibial plateau frature	normal	Bicolumn Plating	CAD	normal
17	shanthi48/m106406TR12389	2 wheeler self fall	type II tibial plateau frature	normal	lateral plating	normal	Normal
18	selvam 63/mTR12390	2 wheeler vs 2 wheeler	Type V tibial plateau frature	normal	Lateral plating	normal	normal

S no	Clinical assessment							Radiological assessment					associated injury
	Pain	Walking capacity	Knee extension	Stability	ROM	Power of quadriceps	Maximum score	Articular depression	Condylar widening	Varus/	osteoarthritis	Maximum	
1	**6**	5	4	6	6	2	29	3	2	3	1	9	nil
2	6	6	4	6	6	2	30	3	3	3	1	9	Shaft of femur fracture
3	6	6	4	6	6	2	30	3	3	3	1	9	nil
4	5	5	4	6	6	2	28	3	3	3	1	10	nil
5	3	5	4	5	4	2	23	3	3	3	1	9	nil
6	1	0	4	5	4	1	15	3	1	2	1	7	nil
7	5	6	4	6	6	2	29	3	3	2	1	9	nil
8	6	6	4	6	6	2	30	3	3	3	1	10	nil
9	6	6	4	6	6	2	30	3	3	3	1	10	distal radius fracture
10	5	6	4	6	5	2	28	2	1	2	1	6	nil
11	last followup												
12	5	6	4	6	5	2	28	2	1	2	1	6	nil
13	3	3	2	6	3	2	19	2	1	2	1	6	nil
14	6	6	4	6	6	2	30	3	3	3	1	10	nil
15	5	6	4	6	5	2	28	2	2	3	1	8	nil
16	3	3	4	3	6	1	20	2	1	2	1	6	T Type Acetabulam
17	5	6	4	6	6	2	29	3	3	3	1	10	nil
18	5	6	4	6	5	2	28	3	3	2	1	9	nil